CHEMICAL & METALLURGICAL ENGINEERING

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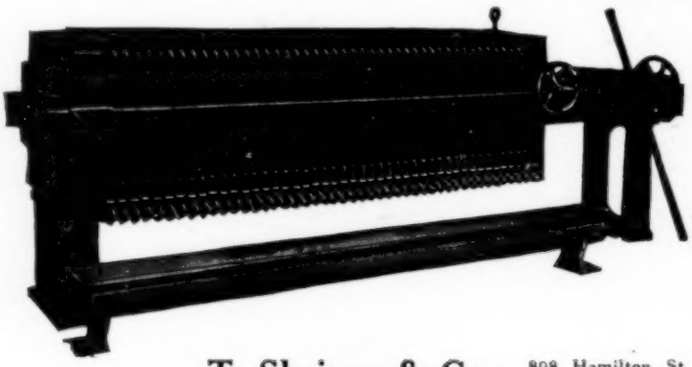

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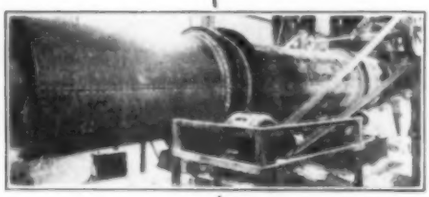

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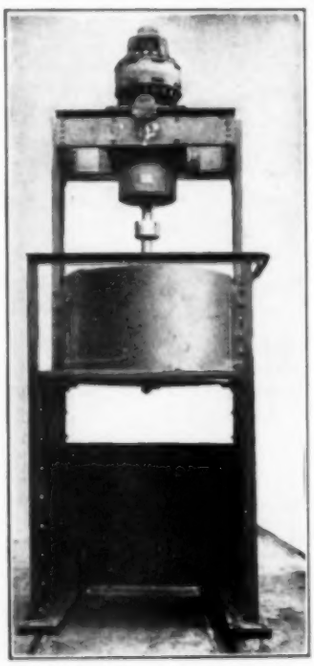

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A Dollar for War, A Penny for Progress

APPROPRIATIONS for the fiscal year ending June 30, as given in the regular supply bills and three deficiency bills in Congress prior to that date, show the national budget to amount to about 5⅔ billion dollars, really a huge sum when most of us can remember the political hullabaloo raised by the first "Billion Dollar Congress." But the size of it, staggering as it is, is not so important as its distribution, as has been brought out very forcibly by Dr. ROSA of the Bureau of Standards.

He arranges the budget into groups. In the first is found expenditures on account of previous wars and our military establishment. Another group covers primary governmental functions—the executive, judicial and legislative. Next comes public works—rivers and harbors, buildings, reclamation and parks. A fourth includes research, educational and developmental activities, such as in the Agricultural Department, Geological Survey, Bureau of Standards and Bureau of Mines, Library of Congress, Public Health and Vital Statistics. Last comes self-supporting activities such as Post Office, Patent Office and Land Office. Tabulating:

Wars	$5,280,000,000	or	93 per cent
League of Nations	0		
Governing	181,000,000	or	3 per cent
Public Works	168,000,000	or	3 per cent
Development	57,000,000	or	1 per cent
Self-Supporting Offices.	balance		
Total	$5,686,000,000	or	100 per cent

For destruction 5,280 millions and for development 57 millions! "A dollar for war, a penny for progress"—a slogan for 1920 perhaps worthy of a place alongside PINCKNEY'S "Millions for defence, not a cent for tribute!" Rather than increase the burden of taxation, the Congress is unable to afford an expenditure of more than 9 cents per capita on the Bureaus of Plant and Animal Industry, 2½ cents on the Bureau of Mines and Geological Survey, 3½ cents on the Bureaus of Standards, Fisheries and Foreign and Domestic Commerce, and the same amount on Public Health Service. Particularly adequate appears an expenditure for education of 7 cents per capita by a national government, one million of whose drafted soldiers could not read and write!

It requires little argument to convince technical engineers that research pays. It requires as little to get an admission from any American that education pays. The moot point is whether the United States Government should finance the research, or how far it should go in supporting education. The determining answer seems to be that it can and ought to proceed energetically along those lines which are basic or fundamental—applicable to many activities of various nature and differing magnitude. The individual farmer cannot of himself experimentally determine the exact advantage of a potash fertilization—his state agricultural school is more likely to be working along those lines if he happens to live in the South. If he lives in the North he will naturally turn to the national Department of Agriculture for an unbiased opinion on his problem.

Similarly in metallurgy and chemistry. Who is interested in collecting data on little-known natural resources with only a remote chance of quick financial reward unless it is the Bureau of Mines? Could one get a better opinion on the proper pyrometer for a certain problem from Dr. BURGESS or from an instrument maker specializing in thermocouples? Where does the chemist go when he wants a certificate of accuracy for a fine thermometer?

Illustrations might be endlessly multiplied to little point, since each individual reader is familiar with one or more of them. Dr. ROSA presents an almost unanswerable argument to the lay mind, however, which ought to be widely used when occasion warrants. Starting from the premise that the Government should be constructive and helpful to the people and to business—generally and without regard to condition or location—in order to establish good relations, elevate business methods, increase efficiency and the general joy of living, it certainly seems that 1 per cent of its total expenses is a very small proportion in view of the economic value of the work. But even a considerable part of this miserable pittance is consumed by activities on behalf of the Government itself—in routine tests and investigations. Even here the Government would spend far less for its purchases if it spent more in standardizing and specifying those purchases and systematically testing the deliveries. Apart from the service the Government can render in educational work, all its scientific and developmental work develops wealth multiplied like fruit from seed. There is now required many times the revenue formerly needed; expenditures for development, however, lighten taxation by largely increasing the taxable wealth. It is as productive and profitable in peace as in war. It constitutes a standby reservoir of unsuspected potential possibilities.

Finally, if the reasons are not already sufficient, there remains the military reason. Who denies that Germany was so hard to beat because she was so well prepared technically? On our part, the development of our intellectual, moral and material resources was a thing consuming time, and costing many, many priceless lives, yet, as the event proved, more indispensable to final success than the initial equipment of armies and fleets. The conclusion is irresistible that a Government that pays great attention to education, research and industrial development is making the best preparation for possible wars in the future. It tends to prevent war, and so pays for itself twice over.

What will our children's judgment be of men who had nothing for a League of Nations, and but 1 per cent for construction?

Another Case Of Secrecy

THERE has just come to attention another instance of unreasonable and wholly unnecessary attempt at secrecy on the part of a certain prominent firm in the metallurgical industry in this country. This corporation has gone to the extreme in having all its plant equipment and machinery built in its own machine shops for the avowed purpose of preventing any outside interests from securing even a clue as to the methods and appliances used in its plants.

We much deplore any policy like this and do not hesitate to criticize the attitude of mind which gives rise to such methods. Under no circumstances can an industry expect to profit permanently by such policy. A free exchange of information and a very general knowledge of and interest in plant processes are the best possible means for encouragement of additional development of the art and industrial advancement of the manufacturing plants engaged within the field in question—indeed, within any line of activity.

No company can afford to take such a stand as this corporation in question. It is out of the question for any one company to know so much about a particular process, metallurgical, chemical, or what not, as to be unable to learn more if research and development are encouraged on all sides. Concentration of industry is desirable up to the point sufficient for best efficiency; but there is no reason for feeling that a reasonable measure of publicity is the occasion for undue competition. If any element of an industry cannot succeed despite a certain measure of competition, because of its greater skill of management or more rapid adaptation of science to the plant process, CHEMICAL & METALLURGICAL ENGINEERING is heartless enough to believe that it does not deserve to succeed. This narrow-minded metallurgical concern is making a success of its manufacturing operations; but we should much prefer to see this success by a frank, open policy rather than by the means which it apparently desires to use.

Chemistry Conquering Another Industry

THE fertilizer business has been very negligent of all branches of chemistry in times past, but we can be much encouraged to see that it is rapidly being convinced of the need for chemical control. One large manufacturer is quoted as saying recently, "Why, we have to analyze almost every shipment of phosphate rock which we receive these days." And the interest in the analysis is by no means confined to the phosphate, for with the present scarcity and high cost of the nitrogen and potash supplies it is increasingly necessary to make accurate determination of all the materials used and the products shipped.

In writing of the present fertilizer situation, Dr. WHITNEY well says that there is an active change going on at the present time converting a sort of "scavenger business" into a true chemical industry. This progress should be accelerated, too, for the urgency of the national food situation will place new burdens upon the fertilizer manufacturer which he will be ill prepared to bear without the best of support by all branches of the related sciences. Thorough knowledge of the materials and processes used will give added power to meet these new demands; and surely there is no more promising means for gaining this added knowledge than through full chemical control.

In this advance within the factory for the production of fertilizer a still larger need for investigation of methods of fertilizer use and application is co-existent. The possibilities of many fertilizer materials coming on the market in the form of practically pure chemicals must be taken into account by the agriculturist. If he can be supplied with the needed amounts of potash, phosphorus and nitrogen in usable form as pure salts, what is the farmer expected to do with them? Thus far the practical application of fertilizer to the soil has been based upon the supply of useful elements mixed with a bulky mass of much less, or in some cases no, fertilizing value. To change from this method the farmer must learn to use the salts in an entirely different way. It immediately is suggested that as all these salts are readily soluble they should be applied in solution. This is all well enough for some of the crops, and this plan might easily be adopted where correct sprinkling facilities are available, as is generally the case in the tobacco-growing districts. But the wheat or corn grower has no such equipment, and a new practice will therefore have to be introduced. It does seem, however, that the possibilities of such complete change as this are not at all out of the question, if we can supply these materials at prices that are attractive to the user.

Stop, Look, Listen, And Keep a-Looking

ONCE more the season of the year has rolled around when the seniors of college are graduated into freshmen of life. In the main they have been taught to listen attentively and absorb everything they have been told in a very credulous manner. The closer they have confined themselves to the details embodied in their courses and the more intensively they have imbedded these few facts in their memory, the greater has been their reward in grades and honors. However, in the school of life, other factors in addition to listening and concentrated attention control the attainment of success. The most important of these is zealous looking and believing better after seeing. Of course this must not be construed that before reaching sophomore requirements in the great world college our credulous freshman must turn into an incredulous, absolute Doubter. But he must have a sense of weights to attach to what he believes, which for want of a better word to embody the idea may for the present be called scruples. When he gets experienced in scruple determinations, he should be classed as a junior and in the interpretation of the weights he has no doubt qualified for the senior class of the school of life.

Now, the world college does not care much about the annual cycles and has no semesters, lecture periods or terms. A man may spend his life in the freshman class or he may ascend into the higher classes almost immediately upon matriculation. There are no flunks, but just promotions, and these only to whom they are due.

All of us unconsciously grade the men we meet day by day. As a personal example, making editorial calls upon men engaged in the industries with which this journal is concerned, after getting sufficiently acquainted, the most desired information is to get his scruples of belief on various topics, especially on those the journal

is printing relative to his field. If he says something to the effect that if all the articles are as full of bunk as such and such a one, which he happens to believe he is entitled to criticize adversely, he is at a loss to know whether to put his entire confidence in any of those articles with which he is only slightly familiar, he is immediately graded out of the freshman class. If he shows a degree of tolerance for the views of the author with whom he disagrees, he has passed through the sophomore class and if he can show better logic in his own channels of thought and not be a mere shallow advocate, he has certainly reached seniority.

This same idea may be expressed chemically and for those not mathematically inclined we will now substitute the salt content for the scruple. How much salt do you, Mr. READER, add as a condiment to the stuff with which you feed your brain? If you don't add any, it is probable that you have a poor mental digester and your brain is nothing more than a warehouse for the facts that someone else is generous enough to think out and store with you. If you are too liberal with your salt and add it in great quantity, it is likely that you have a pork barrel on your shoulders instead of a regular head. You'll need a soaking out or you'll wilt everything new and fresh that you touch.

The man who takes the time to listen and look certainly has the best chances for success. In reading technical literature, his attitude should be that of a listener in an audience of sixty or seventy thousand, several of whom have dared to speak out in meeting. If he has never contributed, he will probably not know how to interpret properly the spirit of the author. If he has contributed, he will stop, look and listen, and if the ideas conveyed in the article interest him, he will keep a-looking and develop them.

Chemistry Gone Wrong

WE LATELY saw a piece of silk that had an interesting history. As raw material there were sixteen ounces to the pound, but after washing this was reduced to twelve ounces. In order to avoid confusion by the higher mathematics of the silk industry, let us keep in mind this pound of raw silk that weighed, first sixteen ounces, and then twelve ounces. The twelve-ounce pound was passed through a bath of stannic chloride and afterward through another bath of sodium phosphate. These baths were repeated alternately a considerable number of times, after which the silk received a bath of aluminum sulphate to swell the fiber. Then back it went to the tin and the phosphate baths again, to charge the swollen fibers with more loading. Then it had treatment in another bath of silicate of sodium. After this it was dyed a fine rich black with logwood, which added more weight. The final treatment was with oil, to give it luster. The result was ninety-six ounces of beautiful black "silk," of which twelve ounces were and eighty-four ounces were not.

Just how long stockings that are made of this fabric will last is a subject for speculation, but the merchant that guarantees that the fibers are all silk and that the stockings contain no cotton is right as to the facts, although the truth may be strained in the exposition. He shows sound business judgment in refusing to accept the return of goods after they have been worn.

The Simple Life For Some Employers

IN THESE times of varied talk and opinions on the labor situation, such as befog the mind of the observer to the despair of any real decision, comes the clear-cut statement of WHITING WILLIAMS, who has spent seven months of investigation among the common laborers in many steel plants and coal mines throughout the country. His research has been made recently and consequently his opinions carry more weight than those of men formerly associated with the laboring class who have grown away from the viewpoint of the worker and become corpulent in purse and body from the general development of industry.

Mr. WILLIAMS says the average common laborer wants first a steady job; second, living conditions permitting full rest when off duty, and third, education in what the employer is trying to accomplish. Briefly and plainly, he requires "joy in his job." It would seem comparatively easy to bring about this condition for the laboring man if the employer has a touch of human nature in his make-up. Let the boss forego too much criticism, although it may be merited in many instances. Let him study his business to keep the supply of work uniform throughout the year, and lend every aid in improving housing and living conditions for his men.

The thing that strikes home forcibly, however, is that the laboring man must feel the importance of his part in the economic structure. The enthusiastic scientific management expert with a goal wherein each man handles only one small operation has carried things to a point where effort has become purely mechanical. The human factor and true craftsmanship have suffered. A large fraction of a man's life is lived at work, and if pleasure cannot be found therein, he becomes useless alike to himself and employer, with a mind filled with bitter resistance.

The situation calls for human sympathy without patronage on the part of the employer, and if he cannot operate on this basis with profit, it is far better that his factory be turned over to someone else or the doors closed.

Fate of The Dye Bill

THE dye bill (H. R. 8,078) is breathing heavily but is not dead yet. Senator THOMAS of Colorado talked against it for nearly a week. Other champions of liberty who lend their voices to importers or to those textile manufacturers who would rather get their dyes cheaply than have their country independent have announced their intention to "speak at length" against it. This indicates an organized filibuster, but it also indicates that if it comes to a vote, it will pass. Much depends on whether Congress adjourns or takes a recess.

It is reported that the European Allied governments have decided to stop supervision of the German dye industry and have consented that Germany may supply as much of the world's dye needs as she can for the next five years. It is also said that the dye industries of England and other Allied countries have failed to keep pace with the development in the United States and they fear that the United States might get as definite a lead as Germany had before. The sales of American-made dyes to Latin America alone in 1919 totaled $3,100,000. And this, according to a bulletin of the Chemical Foundation, is merely the beginning.

Readers' Views and Comments

Microstructure of Iron and Mild Steel at High Temperatures

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read with interest the editorial on "Extrusion or Diffusion" in the April 28, 1920, issue of CHEMICAL & METALLURGICAL ENGINEERING. I am inclined to believe that the casual reader will credit Mr. Scott and myself with much more than the results of our work will justify. We did not intend, as the reader of this article may be inclined to believe, to discredit Dr. Howe's general theory. The evidence he has is too strong to be lightly brushed aside. We did wish to show, however, that in the case with which we were dealing, i.e., steel heated for a considerable period at high temperature and in vacuo, the conditions which then prevail offset any such result that Dr. Howe's theory requires. The reference made to Dr. Howe is to a particular application which he made of his theory in explaining the apparent decarburization of specimens used for thermal analysis under the same conditions as our specimens were heated and not to the theory in general. The conditions which prevail in an enclosed internal cavity are quite different from those at the outer surface of a specimen heated in vacuo; many of Dr. Howe's best illustrations are of specimens showing the condition at the surface of internal cavities.

Washington, D. C. HENRY S. RAWDON.

What Does the General Electric Get Out of It?

To the Editor of Chemical & Metallurgical Engineering

SIR:—One night last week as I sat in the smoking room of a sleeping car there came in, first an elderly man, well preserved and apparently prosperous, who turned out to be the principal stockholder in a zinc company. Then appeared a younger one, an engineer, returning home after installing some machinery in the West. We were the only occupants of that room that evening, and in time the old gentleman began to talk. He started in with such a tirade against the Government that his critical faculties became unusually sensitized, and, as he liked to hear himself speak, he soon developed his art to cover a larger field. His animus against President Wilson seemed to have its origin in the fact that he had been a college professor as well as college president, and this led to an expression of keen distress that we have become no less than a professor-ridden people.

"They're all tarred with the same stick," he exclaimed, "and the trouble is catching. Now it's cropping out in industry. Wherever you go they want some damned professor to butt in. I got no use for 'em. One manufacturer after another is beginning to blow about his old labbatory and a lot of overhead charges that increase the cost of everything. First it was the General Electric Co. and now the Westinghouse and a lot of other little concerns are about as bad; but I got it in for the General Electric because I hold that they started it. They make good machinery—and so do the others—but whenever I buy anything from them I got to pay for their old labbatory when I settle the bill. Either they know their business, or they don't, and if they don't why can't they get some practical man to teach 'em? Who's this Dr. Whitney of the General Electric that they make such a fuss over? Some big college just gave him a gold medal—because he hires a lot of their professors to work for him, I suppose."

"Ever meet him?" asked the engineer.

"No; an' I don't want to," replied the man of zinc. "I bet he couldn't sell a ton of spelter if he took all day at it! And I'd ruther have a good gang of smeltermen with a reliable foreman over them to run my plant than all the Whitneys in the world. As for that fella Langmore [he persisted in calling him Langmore, so he probably was not of Scotch descent], he sure does make me tired. He goes down to Washington and talks by the hour to a lot of professors, and even they can't understand him! What's all this piffle got to do with making machinery anyway? Ain't he supposed to work for the company?"

"Well," remarked the engineer, "they seem to think it pays. You know, they made tungsten ductile, and that improved the electric light service. There was something worth while, wasn't there?"

"Say, every time anybody invents something they give the labbatory credit for it. I'll bet dollars to doughnuts some practical man did the inventing."

"I believe Langmuir had a hand in it," suggested the engineer.

"Aw, don't talk to me about Langmore; he's the worst of the lot. All he done, I'll bet, was to come around and bless it after it was invented. It's like the minister that baptizes a baby and then thinks it's his. He's no more practical than a college professor. He goes down to Washington, as I said, and makes a great hullabaloo over particles that are so small they ain't got no size to 'em. Then him and all the other roosters crow over it. It's nothin' but a lot of damned showin' off; that's all it is!"

"But," remonstrated the engineer, "it seems to be a step toward the better understanding of the phenomenon of light, and if we could only master that it might lead the way eventually to the discovery of a light motor. That would be something practical, wouldn't it?"

"Practical your grandmother! It's tommyrot. Thomas A. Edison invented the electric light. I'll admit that. These other fellas is jealous, and they're tryin' to pull themselves up by their bootstraps. That idea of a light motor is just about the worst I ever heard. Right in line with perpetual motion! Look here; it takes power to make light, but you can't get power from light. That's as bad as runnin' down hill to climb up!"

"Well, it's only the fossil energy of the sun we use when we burn coal, as Prof. Cimician said. It would be more economical to get it direct. That stands to reason, doesn't it?"

"I don't doubt it stands to the reason of this Prof. Shimmy, or whatever his name is, but you know as well as I do that it ain't practical. You might as well use windmills."

"I've often thought we might use windmills more than we do. Some day we may have sense enough to come back to them. But let's come down to something more familiar. Take the smelting of zinc, for instance. Doesn't that need research?"

"Now I think I know what I'm talking about when it comes to zinc, and I tell you it don't need research or any other monkeyshines to smelt it. *We know how to do it*, and have since your granddaddy was your age. You just put that in your pipe and smoke it!"

"Yes, but the furnaces are very small, the design is antiquated, the physical chemistry of the reactions is hardly studied, and the waste of heat in smelting zinc is out of all reason compared with smelting copper or iron. Wouldn't it be worth while to cut down the cost by gleaning some more knowledge of the subject and making practical applications of it?"

"It's easy to see," the old gentleman retorted, "that you don't know anything about the zinc business. We install the best and most economical furnaces that can be designed at a point where fuel is cheapest. That's what experience teaches. That is the practical fact, and it is not theory. No, sir; all that's needed in the zinc business is to keep up the price of spelter. Then we'll make you all the zinc you want. I'm going to bed. Good-night."

And to bed he went. But somehow I felt drawn to that engineer. I asked him to stay until I returned with my satchel, to which he agreed. In it I had a little legacy from a dear aunt who had often been a source of inspiration to me, but who has passed from us. I refer to Mrs. Ethel L. Cohaul. I shared my legacy with him.

MARTIN SEYT.

Spark Coil for Explosion Pipettes

To the Editor of Chemical & Metallurgical Engineering

SIR:—In these days of the high cost of chemical equipment any substitution that can be made in the interest of economy which does not result in impairing efficiency is apt to receive a hearty welcome. Doubtless the following idea has occurred to many other chemists, but as I have not yet seen it in print I hope that some others will find the substitute to work as well as I did.

Some time ago the writer had occasion to direct some work involving a number of analyses of combustible gases. A gas analysis apparatus of the Steel Corporation type was available, but it was impossible to get a spark coil for it without some delay, and some sort of substitute must be sought.

A Ford spark coil proved the solution, and, needless to say, it could be purchased at once. These coils will give a spark of at least ¼ in. under the pressure in the cylinder of the car at the moment of explosion and at atmospheric pressure the spark will be about ¾ in. long —plenty long enough for this sort of work. We found two dry cells adequate for the primary current.

The only adjustment required is some sort of a clip to make contact with the disk on the side of the coil, and various ways in which this may be done will suggest themselves to the reader. As simple a way as any is to fasten a piece of spring steel or of brass across the disk with screws in the wood casing. This clip will hold the leads in contact with the terminal. This type of apparatus, according to our experience, is just as satisfactory as any Ruhmkorff induction coil and considerably cheaper.

GEORGE S. TAYLOR.

Holyoke, Mass.

British Chemical Industry

(FROM OUR LONDON CORRESPONDENT)

London, May 7, 1920.

THE question of wages of workers in chemical industries referred to in my last article[1] has been settled for the time being, the Chemical Industrial Council having conceded an advance of about $2 per week plus 12½ per cent. The negotiations were prolonged and difficult owing to the attitude of a small section of extremists among the workers. Fortunately for the industry, the manufacturers' representatives possessed a lengthy and intimate knowledge of labor and in some cases were specially released from highly technical and executive appointments for the good of the industry as a whole. Although there is some hope that there will be a peaceful interval, the situation is really dominated by the activities of other trades unions, which are displaying considerable rivalry in securing the best possible terms for their members, with the result that a concession to any one union immediately brings in its train, irrespective of existing agreements, further demands from others whose jealousy and cupidity have thus been aroused. It is felt that unless industry as a whole combines to put a stop to this procedure, wages and prices will rise to such an extent as to render something in the nature of a miniature revolution inevitable, and it is small comfort that conditions in the United States and elsewhere are shaping in a similar manner.

"CHEMICAL TRADE YEAR BOOK"

This buyer's guide, which is a descendant of the "Trade Directory" last published by the *Chemical Trade Journal* in 1911, has just been issued at the price of 10s. by Bandon & Morris, of 17 Red Lion Passage, London, W. C., 1. In conjunction with the official directory of the Association of British Chemical Manufacturers, it will no doubt be of service to American merchants and manufacturers, although it cannot be described as either representative or complete. The Directory of the Association of British Chemical Manufacturers is obviously issued solely in the interests of its members, while the "Chemical Trade Year Book" not unnaturally consists essentially of those firms that have paid for advertising space. To be really complete and of value, such publications should be more on the lines of the American "Green Buyers' Guide" or the "Chemical Engineering Catalog," the former of which is particularly comprehensive and complete and is, moreover, issued free of charge. In addition, many of the firms quoted are often not the actual manufacturers or agents, but are acting as "ghosts" to others. It is hoped that this note will be of some service to American firms that may have occasion to consult such directories.

MR. BARTON BOOMS THE CLAUDE PROCESS

Evidently as a counter-blast to the official announcement of the acquisition of the government synthetic ammonia factory and interests by the Brunner-Mond syndicate, the merits and prospects of the Claude process have just been advertised in the daily press.[2] It will be remembered that the Claude process consists essentially in the use of very high pressures of up to 1,000 atmospheres as against the 200 atmospheres previously employed, greatly increased yields and a substantial

[1] See CHEM. & MET. ENG., vol. 22, p. 828; May 5, 1920.
[2] See CHEM. & MET. ENG., vol. 22, p. 389; March 3, 1920.

reduction in the quantity of catalyst required being claimed. According to Mr. Barton's announcement, it is proposed to form a company known as Atmospheric Nitrogen & Ammonia Products, Ltd., with a capital of $10,000,000 and to erect a synthetic ammonia plant in Cumberland adjoining a large coke-oven plant owned by the same company. Interesting features are the announcement that the necessary supply of hydrogen will be obtained at a very cheap rate by special treatment of producer gas and that it is intended to place on the market, as a new type of fertilizer, ammonium chloride derived from synthetic ammonia, instead of ammonium sulphate, as in the case of other manufacturers in this branch of the nitrate field.

Status of Chemical Market

There has been practically no change in the chemical markets during the past month, but it cannot be stated that supplies are as yet approximating to the demand, particularly in regard to heavy chemicals and such items as formaldehyde, acetic acid and acetone. Mercury has also been a strong feature, but prices now show a downward tendency. As regards dyestuffs, there is still a shortage and great difficulty in making this up from Germany owing to the reduction in output due to shortage of coal in that country.

Future of Explosives Factories

The enormous cordite and explosives factory at Gretna will probably be continued and the original government factory at Waltham Abbey dismantled. In addition, it is proposed to use the ether-alcohol plant at Gretna for the purification of commercial methyl alcohol, and it is hoped that there will be an adequate demand for this from the dye, medicinal, photographic and other chemical industries, and also for ether, possibly in connection with the development of power alcohol. In regard to the latter, extensive new laboratories and a special staff of assistants are being provided for the government chemist and experiments are to be carried out on manufacture from vegetable substances and in regard to denaturing. The problem of finding peaceful uses for munitions factories is gradually being solved, and small arms, ammunition and fuse works are turning their attention to mechanical and other toys, clocks, sewing machines and the like, while Kynoch's large works at Arklow, in Ireland, are to be used for the manufacture of artificial manure in conjunction with the development of the Avoca copper mines. The new company is to have a capital of about $12,000,000.

Conference of Chemical Engineering Group

The third Conference of the Chemical Engineering Group dealt with labor-saving devices in chemical works, and while the papers presented were on the whole somewhat mediocre, they serve to focus attention upon the growing tendency of British manufacturers to eliminate manual labor wherever possible. An interesting point brought out during the discussion was the extensive use made in Germany of pneumatic conveying of materials and chemical substances, hot air being sometimes used with the object of simultaneously drying the material on its way from the hydro-extractors, etc., to the packing room. The subject of the next Conference in July at Newcastle is to be filtration, a subject which has not received the same careful attention in this country as in America, owing to the more restricted field for continuous and automatic appliances. It is, however, interesting to note that Vickers has recently undertaken the manufacture of the Gee type of centrifugal filtering and grading machine developed by Centrifugal Separators, Ltd., and that these machines are being extensively introduced in the china clay industry, in paint and composition works and even for the separation of sludge from sewage and the waste liquors and outfalls of chemical works. The machines not only filter but grade the precipitate, and their chief disadvantages appear to be the impossibility of washing the precipitate and discontinuous operation, difficulties which are likely to be overcome.

Colloidal Fuel

Another new company to exploit this process is a private one, the United Oil & Coal Corporation, Ltd., and it is rumored that L. C. Harvey, the European manager of the Fuller Engineering Co. of America, is a director. G. C. Calvert of the Metropolitan Laboratories, London, is stated to have patented similar mixtures under the name of "Colloil," while in regard to the application of these mixtures to railway work, experiments are being conducted by J. G. Robinson, chief engineer of the Great Central Railway Co. The latter have proved very successful, giving results fully equal to the use of bituminous coal, and it is stated that Mr. Robinson has developed a new type of burner, the dust and oil being mixed at the burner instead of previously, thus eliminating the use of a fixateur or peptizing agent.

Personal Notes

Sir Henry Birchenough has been appointed chairman of the British Dyestuffs Corporation in place of Lord Moulton, whose advanced age and heavy judicial work prevent him from continuing his work in this connection.

Prof. Henry Louis has been appointed foreign secretary of the Society of Chemical Industry in place of Dr. R. Messel, F.R.S., whose death last week is universally regretted.

Sir Richard Glazebrook is the first president of the new Institute of Physics, which has just been founded by the co-operation of the Faraday Society, the Optical Society and the Physical Society of London.

An Anglo-American amalgamation may be recorded, the British interest of the Monsanto Chemical Works, St. Louis, having amalgamated with R. Graesser, Ltd., of Ruabon, North Wales, under the style of the Graesser-Monsanto Chemical Works, Ltd.

Italy to Use Explosives in Agriculture

With a view to disposing of the surplus supply of explosives and at the same time benefiting agriculture, a series of experiments has been conducted by the Italian Ministry of War in connection with the breaking of ground. The results have been so satisfactory that it has now been determined to proceed to the practical use of explosives in agriculture on a large scale. In addition to preparing the land for cultivation, it is claimed that the use of certain explosives not only destroys parasites but also to a certain extent reduces the necessity for fertilization. It is proposed to establish in all districts of Italy demonstration fields where trials of the system which has been adopted will be carried out; such fields have already been created in Umbria, Puglie, Tuscany, and the liberated provinces. At the same time, the Ministry of War will turn over the large quantities of available explosives at favorable prices.

Scientific Control of the Filter Station—I

A Discussion on Clarification of Filtrate — Use of Lighter Filter Cloths Made of Open Woven Fabrics Advocated — Form of Solids in Cake Important — Method of Application and Use of Filter-Aids

BY ARTHUR WRIGHT, M. E.

INDUSTRIAL filtration, as it has been so aptly put, "is a lowly art." Yet for so many years have rule-of-thumb methods obtained, it is consistent that with the introduction of the modern filter we are beginning to recognize that there are fundamental principles underlying the best operation of these filters. Filtration is no longer summed up in the old adage, "get a good hard cake," but comprises, in addition to clarification, the complete washing of the soluble from the deposited solids, the drying of the cake, thorough discharge of the cake so that the filter medium is maintained in a free filtering condition for recurring runs, and a consideration of pumps, filter cloth and other auxiliaries. It is only when these principles are understood and applied that the filter station reaches its true economy and efficiency.

Much effort has been made to acquaint superintendents and managers of plants with the advantages and fine points of the different types of filters, but inadequate attention has been given to instructing the operators. The results, so often recorded, of machines starting with capacities far in excess of requirements and a month later lacking capacity are due, time and again, to inefficient operation traceable to ignorance on the part of the operator. Superintendents should know the "tricks of the trade" in order to exercise intelligent control, but the operator should be the plant's expert on the particular material being handled and it should not be left to him to learn by graduating from the school of experience. That is too costly. To instruct him is cheaper and not difficult even with foreign unskilled labor.

To go into the detail necessary to bring out the underlying principles would make a single article too long, and it has been thought best to divide this subject into five papers with the separate headings; 1, Clarification; 2, Rate of Flow; 3, Washing and Drying; 4, Discharging; and 5, General Discussion and Auxiliaries. This is the first, on clarification, the others will appear in subsequent issues of this paper.

CLARIFICATION

Clarity of filtrate is in the vast majority of cases the primal object of the filter, but, as will be shown later, it is too often over-emphasized. When absolute clarity is not required, a different attack than will be here outlined is often possible.

The number of cases where capillary attraction and adsorptive action are real factors in clarification are relatively so few and far between that this general law can be defined: Clarity of filtration is due to superlative straining of the particles of suspension from the liquid in which they are suspended. This statement will doubtless call for criticism from some quarters, but it is held to be basic by reason of success obtained in handling a large number of problems completely ignoring capillary and adsorptive actions and concentrating solely on straining.

OPEN WOVEN FABRICS

The choice of straining or filter medium determines the nature of the straining or filtering. It is the popular belief that woven fabrics effect clarification by surface filtration; i.e., that the solids are caught on the surface of the fabric and build up to form a cake. Such a belief is rational when comparing a woven fabric to a granular bed filter medium. It is obvious that any particle penetrating the surface of a sand bed has opportunity to be caught in the interior of the bed before issuing from the false bottom as cloudy filtrate. Both theories are, however, subject to a liberal interpretation, for we have only to witness the number of times the filter cloth is clogged and not opened even though the surface be hand-cleaned with vigorous scrubbing and the cloth given reverse washes. Or, again, to watch the working of boiler feed-water filters wherein the initial flow is not clear and after running clear can run for a period only before the filter must be cleaned.

The answers are obvious. In the former, solids penetrate into the cloth and are firmly held in the meshes of the cloth—surely not true surface filtration. In the second case, clarification begins only when the retained solids form of themselves a filter medium on the top of the sand bed. The reason that the rate of flow is approximately constant in sand filters is that as the deposit on the bed builds up it has the effect of building up a resistance to the flow, increasing the filtering pressure. At some point this pressure builds up sufficiently to force the deposit through the surface of the sand bed and to work into the interior. Manifestly, if the filter is run long enough, the solids will issue through with the filtrate. In point of fact, therefore, the initial filtration through fabrics approximates filtration through-a-depth and with sand beds true clarification commences with surface filtration.

SURFACE FILMS

With the above in mind we have ground for the contention that too many industrial filters are equipped with too dense a filter cloth. Mechanical wear will often dictate the choice of a heavy cloth, but this should not be the signal to use a dense cloth. It cannot be expected that with the use of open cloths the initial clarity will be satisfactory, but it will be found that there is no hardship in refiltering the first runnings. Usually the filtrate brightens up readily and the amount to be returned can be added to the feed of the filter or else run through a separate filter which is used as a "polisher." Local conditions will govern the best means of handling this cloudy filtrate.

It is not practical to equip the filters with a more open cloth or a thinner fabric and not provide for the handling of cloudy filtrate. Absolute clarity can sometimes be obtained with such cloths by working with a low initial pressure, as for instance, gravity feed. There are cases where this is good practice, but as a general rule it is precarious, for it is required only that an insufficient deposit be made on the cloth when the pressure line is opened and the solids are pushed through into the filtrate. The basic idea is that the clarification shall be effected by virtue of the deposit of the solids on the filter cloth rather than that the cloth shall be the real medium. If this be carried out, it will be found that those particles which clog the dense cloth pass through into the filtrate so that the open cloth is maintained in a free filtering condition for recurring runs. This, of course, is obvious and need not be elaborated upon save to consider further the kind of cloth to use.

Use of Double Plies

It must be borne in mind that cotton is a cellulose product and with very few exceptions swells when immersed in liquids. Consequently, weaves that seem quite porous before wetting are quite dense afterward and similarly, loosely woven fabrics that will often seem flimsy when cut upon the table will prove quite substantial in practice. Many investigators have been impressed with the excellence of thin muslins, but have been deterred in their use by reason of their frailty. Such mediums are indeed very efficient, for they effect the nearest approach to instant surface filtration and by reason of the thin yarn from which they are woven do not clog up if their surface be cleaned—not enough thickness to hold solids.

The writer has seen installations where thin cloths were used, but in order to increase their strength two layers were used. This usually proves to be a poor expedient, for the conception that the inner cloth backs up any rent or tear of the outer cloth is not well founded. To obtain this result the two layers should be made integral one with the other by close lateral stitching or by spot pinning, etc. Then the possibility of a wrinkle in the outer cloth occurring at the point where the cloth is broken is decreased, but such a procedure has the same effect as if a heavy single cloth were used and there is no advantage worth the effort.

To prove the futility of double thicknesses of muslin one has but to inspect a filter so equipped that has been in operation a few days and note the accumulation of cake that occurs at the bottom of the leaves or plates. This increases with every run and is accounted for by the fact that the outer cloths are ripped or have "pin" holes, so that the under cloth must do the filtering at such points. More cake builds up than can clear through the hole when the filter is discharged, and this excess works down to the low point of the leaves.

Fabric Re-enforcement Gives Satisfaction

The idea of re-enforcing the muslin so as to strengthen it is good, but the under cloth must be of an excessively open weave such as "hose duck," burlap, cocoa matting or the like. Then any solids penetrating the muslin issue from the leaves as cloudy filtrate. It is amazing to what extent the muslin can be torn and still give good service under such conditions. The length of life of the muslin is then made positively practical even when using those machines that require the cloths to be sewn to the leaf. Diverse opinions have been rendered on this subject, but the writer is much impressed with the working of a battery of Sweetland filters having an aggregate filter area of over 7,000 sq.ft., where, after a thorough investigation was made of this point by several months' experimentation, muslin backed by burlap was used; the life of the muslin doubled, the output increased, and material economies were effected.

What is true about providing for cloudy filtrate when using cotton filter cloths is even more pertinent when using metallic cloths. These fabrics are designed as permanent mediums and their initial cost is justified only by their long life. Consequently, how much more fatal it is to allow these cloths to clog up. Users are the best judges of the delays and trials when caustic, acid and heat treatments are resorted to in order to regain their porosity. So much of this is needless if only provision be made to take care of cloudy filtrate and an open weave of uniform mesh be used. In a later article scale formation and its prevention on metal cloths will be dealt with and should not be confused with this subject of clarity.

Importance of the Form of Solids in the Cake

Much of the above is needless precaution for those handling materials with solids of a crystalline nature. There are niceties in their efficient handling, but there is none in respect to clarification save where some impurities are likewise present, the nature of which is not crystalline. In such cases the above is of positive importance.

A case occurred in a plant where calcium sulphate was thrown down from an acid liquor, but a considerable percentage of flocculent precipitates were present as well. The superintendent and chemist were advised of the advantage of using open cloths and tried them. They reported utter failure; the clarity never did become brilliant. One glance at their cakes as discharged from the filter told the whole story. As every filter manufacturer warns against the formation of tapering cakes due to inadequate agitation in the filter, they were informed on this point, but, in that they were not troubled with poor washing, had no difficulty discharging, and the leaves were not warped excessively, they were not equipped for thorough agitation in the machine. In consequence, with their open cloths the upper part of the leaves was subjected to the work of clarifying the lighter solids that were fine enough to penetrate the filter cloth and did not coat the surface with a substantial deposit. This instance serves to show the relation of agitation to clarity and also illustrates what small, insignificant factors can often be the deciding point between success and failure in this art of filtration.

Use of Filter-Aids

Decantation prior to filtration is often practiced and more opportunities are afforded these days for its use by reason of the excellent record of the continuous types of thickeners. The main advantage of decantation is in increasing the capacity of the filter with the possibility of using continuous machines in place of intermittent types. There are numerous cases where this procedure is eminently advantageous, but in the main it is confined to those materials that readily settle with a satisfactorily clear supernatant liquor. Where the

supernatant needs further clarification, the usual experience is that such a procedure is really "two bites at a cherry," and the clarification of the decanted liquor with its finely divided particles is a matter of nice control if anything approaching efficient operation is to be had. This clarification is made far simpler, however, if the solids are waste products such that a filter-aid may be added without chemically affecting the filtrate.

The use of filter-aids as agents assisting clarification is rightfully being recognized as efficacious, and they are being employed more and more. A filter-aid, whether the specific products on the market or a waste industrial material such as calcium sulphate, calcium carbonate, sawdust flour, pulverized bone-black, etc., must have three main properties. Its specific gravity must be such that when mixed in water or the liquid being filtered it will stay in suspension sufficiently to be easily handled in the filter; its filtering characteristics must be high and its chemical composition inert or harmless to the liquid. In this paper the discussion is confined to the use of filter-aids as clarification agents, and their use as aids in increasing the capacity, discharge, etc., reserved for later treatment.

Pre-Coating the Cloths

The fundamental use of a filter-aid as a clarification agent is in producing an auxiliary filter medium upon the filter cloth by means of "pre-coating." Pre-coating is the term used to define the initial filtration of a filter-aid before opening the main liquor line. This filtration is generally only for a minute or two, and it is sufficient when the effluent issuing from the filter is brilliant. Too often the impression seems to be that this coating must be of some sensible thickness, one-eighth or one-sixteenth of an inch, where, in fact, a film is quite sufficient. On raw sugar liquors it is practical to pre-coat the cloths, using 1 lb. of "filter-cel" per 100 sq.ft. of filter surface, and on examination of a filter leaf after coating it will seem to be without any deposit, but the clarity of the filtrate will be found to be brilliant when filtering the sugar liquor and a white surface will be noted on the inner face of the cake when discharged. This is possibly the minimum amount to use and safer results are obtained by doubling this amount, but even this will give a coating difficult to measure and no liquors have been encountered, to date, that will not give brilliant filtrate through it. Obviously, more than this is an extravagant use of the material and unnecessarily increases the initial resistance of the medium.

Methods of Applying Filter-Aids

The vehicle to use for this pre-coating is a matter for local decision, but there are three methods in practical use giving eminent satisfaction. First, to make up a slurry of the filter-aid and water (or when handling varnishes, etc., some solvent), and to filter it in the usual manner, shutting off when the filtrate is brilliant. In most machines the amount of unfiltered slurry demands its withdrawal from the filter before admitting the sludge. Best practice, therefore, is to locate the slurry mixing tank below the filter so that the excess unfiltered in the machine may be drained back, using the minimum of air pressure to hold the coating on the cloths.

To obviate this draining back some plants use the second method, where clarified effluent is used instead of water or the solvent and sufficient filter-aid is added to insure a pre-coat when the following operation is carried out. The pre-coating liquor is admitted to the filter until full, when the regular liquor is fed to the machine. Experience shows that the first deposit on the cloths is the filter-aid and that there is no trouble in getting clarity nor in dealing with excess unfiltered liquors. The layout for this method is usually to locate the pre-coating tank above the filter so that no pump is necessary to feed the pre-coating slurry to the filter, gravity feed with large pipe lines being sufficient.

The last method is that so extensively used in the sugar refineries of the United States and Canada. Here the solids of suspension in the liquors to be clarified are present in relatively low percentages and it is found quite practical simply to add sufficient filter-aid to the unfiltered material so that the volume of the filter-aid far exceeds that of the original solids. This liquor may then be fed as in the second method. The coating will be found to be such a close approximation to straight filter-aid that the practical results are the same.

Where positive clarity of filtrate is essential, as in the manufacture of artificial silk, this scheme of an auxiliary medium is well nigh indispensable., Local conditions may exact some research in order to find that filter-aid best suited to the requirements, for while "filter-cel" is almost a universal material, it is not best when handling heavy caustics or some food products, to which the "filter-cel" imparts a detrimental taste. In any case, however, to persevere and find the right material will be found well worth the effort.

(Part II, dealing with the Rate of Flow, will be published in a subsequent issue.)

Growth of Manufacturing Industries in New South Wales

Figures released in January by the statistician of the government of New South Wales show that the industrial growth of that state has been rather limited, as the number of manufacturing establishments increased only from 5,269 to 5,450, involving an increase during this period of only 9,870 in the number of employees, or 1.7 per cent per annum, making a total of 126,481 of such employees on March 31, 1919. The male adult workers, whose salaries averaged $636.48 in 1914-15, averaged $764.89 in 1918-19, which have been further increased by the all-around advance of about $4.12 per week, following the Board of Trade's decision that the basic wage should be $18.84 per week. During the same period the total output of factories in the state increased in value from $331,511,193 in 1914-15 to $509,224,467 in 1918-19, but a large portion of the increase indicated is due to increased values rather than to output.

Chicle Gum in British Guiana

Announcement has been made in a report submitted by Consul McCunn of the discovery of chicle-producing trees in British Guiana. Prospecting expeditions sent into the interior have recently returned to Georgetown with full 600 lb. of chicle, and preparations are now being made by the discoverer, who holds a concessional right over 6,200 square miles of territory, to send out four prospecting parties in order to continue investigations and ascertain the capacity of the tract. Territory thus far examined is reported to be capable of yielding 200,000 lb. of gum annually.

Calcium Molybdate as an Addition Agent in Steel Making

By Alan Kissock

IN THE production of alloy steel, molybdenum, like most similar metals, is commonly added to a steel bath in the form of a ferro-alloy, usually less than a half an hour before the furnace is tapped.

In the open-hearth furnace practice varies, from melting the ferro in a small electric furnace and making a hot metal addition, to crushing to about one-quarter mesh and adding it cold, or, as is perhaps most common at present, the alloy is thrown into the furnace, container and all, just as it comes from the manufacturer. In the electric furnace, with its more concentrated heat, the manner of introduction is of lesser importance.

Formerly a ferro containing from 75 to 80 per cent molybdenum was generally specified. Because of the difficulty of securing an ore suitable for manufacturing such a high-grade alloy, and because of the high melting point of the metal, with attendant difficulties of production, the cost of this alloy was necessarily high. In the continued attempt to decrease production cost, and since there can be no real objection on the part of the steel manufacturers, more recent practice has been to produce a ferro containing approximately 50 per cent molybdenum. This grade of ferro, besides being less costly to produce, is perhaps the principal factor in the success of its direct addition to steel. Its lower melting point is responsible for less segregation and eliminates the necessity of pre-melting or fine crushing.

Merit and Cost of Molybdenum

In the attempt to create or stimulate the use of anything new, the first requirement is to establish its merit and secondly to decrease its cost. The first requisite—the value of molybdenum as an alloy for certain steels—is continually becoming better known. Principally from lack of demand, the war-time price of ferromolybdenum has fallen considerably, but if the metal is to find extensive use it is necessary that a reasonable and more constant cost be established.

In deposits of commercial extent, molybdenum seldom occurs in percentages sufficient to permit, even by the most efficient known means of ore concentration, a recovery of greater than 10 lb. of metal per ton of crude ore mined. Often considerably less may be extracted. A great many costs, therefore, must be charged against these few pounds of metal recovered, from the mining, through the often-difficult concentration, to the final transportation.

To these must be added the cost of electric smelting with its heavy losses, even in the best of practice, the difficulties of coming within the customarily rigid specifications of the consumer, and the uncertainty of selling the product when finished. It is easily seen, therefore, that if a fair and reasonable return is to be made to the producer, ferromolybdenum cannot become cheap enough to compete largely with some of the more common steel-alloying elements. Assume that every possible cost of mining and treatment has been brought to its lowest point. Then if any further decrease in cost is to be obtained, it becomes possible only through some improvement in the metallurgical treatment or through the elimination of some step in the preparation of a suitable product for the steel manufacturer.

With these facts in mind, it occurred that it might be possible successfully to introduce molybdenum into steel by the use of a salt of the metal rather than by the use of ferromolybdenum. Could this be efficiently accomplished, then the electric-furnace reduction of ores and products would be eliminated and in its place a much lower-cost chemical treatment could be substituted.*

Chemical Compounds as Addition Agents

The idea of introducing an alloying metal into steel by means of some salt or compound thereof is not particularly new. It has been tried, both in the furnace and in the ladle, with certain of the metals, and with more or less success. Several difficulties, however, are encountered in considering the more common salts or compounds of molybdenum.

The ordinary 60 per cent molybdenite concentrate, or even the higher grade, is unfit for direct addition for several reasons. All such concentrates contain a certain proportion of silica and in basic furnace practice it is desirable to avoid, as far as possible, any introduction of silica into the bath. Upon addition of molybdenite to steel at least a portion of the ore would be converted into the trioxide and as such would readily volatilize and be lost. The most serious objection, however, is the 25 to 30 per cent sulphur content of high-grade concentrates. In a test made at the plant of the Southern California Iron & Steel Co. in Los Angeles, an attempt was made, by the addition of high-grade molybdenite, to introduce 0.4 per cent molybdenum into steel. It was found that although a considerable proportion of the molybdenum entered the steel, sulphur, with its great affinity for iron, was also introduced to the extent of 0.25 per cent. By long treatment in the furnace, with manganese and lime additions, this sulphur content might have been lowered, but with the furnace-man's constant effort to keep the sulphur low in his product, a molybdenite would hardly be looked upon with favor.

Roasted molybdenite concentrate or trioxide of molybdenum would serve as a direct addition agent, were it not for the ease with which this compound is volatilized. At 1,200 deg. F. the vapor pressure of molybdic oxide is quite high, so that recoveries from an addition at steel-furnace temperatures would be unprofitably low. Such roasted concentrates would also carry the silica gangue of the unroasted material, and though it is possible to manufacture a more pure trioxide, the cost of such is prohibitive.

Since molybdenum unites in varying proportions with oxygen, it is possible that one or more oxides might be found which would not be volatile at furnace temperatures. The difficulty, however, of efficiently producing such oxides makes such compounds of doubtful value for consideration as addition agents.

Sodium molybdate might serve as another possible agent but for the higher cost of producing it of a sufficiently high molybdenum content.

In the case of some molybdenum ores, a step between concentration and the manufacture of ferro involves either a furnace or a chemical treatment for the removal of possible impurities and the production of an alkaline salt of molybdenum, preferably calcium molybdate. Although in the production of ferro from molybdenite it is not always necessary to precede electric furnac-

*Compare, for instance, J. P. Bonardi, "Notes on the Metallurgy of Wulfenite," Chem. & Met. Eng., vol. 21, p. 364, Sept. 15, 1919.

ing by a roast or wet treatment, such a process can be readily applied and a calcium molybdate of high grade very easily produced.

Theoretically, calcium molybdate should serve as an excellent addition agent to steel. It can be easily and comparatively inexpensively made of a high grade, containing practically nothing but the oxides of molybdenum and calcium. The salt is easily reduced and the lime apparently prevents loss by volatilization of the molybdenum trioxide. Upon reduction of the molybdenum, by the carbon or silicon in the steel, the lime would simply serve as a small added source of material for the ordinary basic slag.

Early in 1918, in New York City, several small steel heats were made. An experimental electric furnace was employed and molybdenum was successfully introduced by the use of calcium molybdate with a recovery of 95 per cent.

Encouraged by these tests and with the kind co-operation of P. E. McKinney, metallurgist at the U. S. Naval Gun factory, a commercial test was made at the Navy Yard in Washington, in September, 1918. The calcium molybdate was made from the wulfenite ores of the Mammoth Development Co. of Los Angeles, and furnished gratis by that company for the test. Using a Heroult furnace, six tons of scrap was melted and at the proper time sufficient calcium molybdate added to introduce about 1 per cent molybdenum into the steel. The molybdenum content of the product, as shown by final analysis, confirmed commercially the previous experimental results. At a later date, C. E. Margerum, metallurgist of the U. S. Naval Ordnance plant at Charleston, W. Va., repeated the success secured at the Navy Yard in Washington. A third electric-furnace test was made at the plant of the Carbon Steel Co. in Pittsburgh, Pa. A 6-ton Heroult furnace was employed, and a repetition of the success of the two previous heats gave ample assurance that calcium molybdate was a satisfactory addition agent for use in the electric furnace.

Molybdate in the Open Hearth

Having succeeded in these attempts, it was conceded that because of the strong reducing action of the electric furnace, the results obtained were to be expected. That the same success could be secured in the strongly oxidizing atmosphere and action of the open-hearth furnace was, however, open to argument, and considerable skepticism had to be overcome.

Experimentation has shown molybdenum to have less affinity for oxygen than either iron or carbon. Industrially, this is again proved by the fact that once in the steel bath neither "oreing down" nor "boiling" appears to lower the molybdenum content.

Provided the molybdate could come in direct contact with the molten metal, it was thought that the salt might be reduced either by the metallic iron itself or by one of its reducing constituents. By the courteous aid of the officials of the Carbon Steel Co., 50 tons of pig iron and scrap was charged into one of the basic open hearths at their plant in Pittsburgh during November, 1918. At the proper time sufficient calcium molybdate was added to introduce the desired percentage of metal. Analysis of the ingots produced showed a high recovery of the molybdenum added, and the success so attained amply rewarded the effort expended.

Early in May, 1919, with the kind interest and co-operation of the staff of the United Alloy Steel Corporation, a second open-hearth test was arranged. Two 100-ton heats and a third but smaller basic furnace heat were made and the desired amount of calcium molybdate added in each case. The practically complete recoveries of molybdenum secured proved beyond question that molybdenum in this form may be successfully, and very efficiently, introduced into steel made in the open-hearth. In all tests, rolling mill recoveries correspond with those usually obtained with the customary ferro addition.

In order that the molybdate may come in direct contact with the molten iron, it is necessary that the addition be made in the early stages of the heat. In one of the tests the molybdenum was in the open-hearth furnace over a 14-hr. period and under very severe oxidizing conditions. The fact that the molybdenum content remained practically constant is proof of another very important consideration in connection with the metal. It is conclusive evidence that molybdenum, like nickel, and unlike vanadium, "stays" with steel. In the use of molybdenum, therefore, the "crops" and scrap ordinarily encountered in all alloy steel manufacture can be remelted with but little loss, thereby reducing the amount of alloying metal required. Because of the economy that may be effected, the importance of this fact must be appreciated when considering molybdenum as an alloying metal to replace certain of the metals now being used, and for purposes in which it may serve equally well.

Method of Operation

The introduction of molybdenum into steel by means of calcium molybdate involves no complications whatever, it being only necessary to bear the following in mind:

With the strongly reducing action and concentrated heat of the electric furnace, the time of addition is of less importance. Best results have been secured by introducing the molybdate immediately after skimming of the first, or phosphorus slag, the final or white slag indicating, of course, that reduction has been complete.

In open-hearth practice, the molybdate must be added in the early stages of the heat, not with the charge because of possible loss in the furnace bottom, but preferably a little before the melt becomes "level." In other words, in any type of furnace it is only necessary to remember that the molybdate must come in *direct contact with the molten iron,* and therefore in the basic open-hearth it must be added just before the lime begins to come up. A layer of slag would completely prevent contact with the metal. Shipped in sheet iron drums of convenient size, the molybdate is added, containers and all.*

Advantages

From the standpoint of the miner the production of calcium molybdate is particularly advantageous. In almost every occurrence, molybdenite is associated with considerable percentages of both iron and copper sulphides. In order to produce a marketable concentrate, all of the copper and a considerable portion of the iron

*All rights to the process as outlined, both in the United States and foreign countries, are covered in U. S. Pat. 1,300,279, and are owned by the Steel Alloys Co., Investment Building, Los Angeles, Cal. It has been arranged that license to use the process will be furnished gratis by the Steel Alloys Co. to any steel company that may purchase calcium molybdate from such molybdenum producers or sellers as may be specified upon the license. Since it is expected, however, that the arrangement mentioned will be made with all principal molybdenum producers, no hardship to the steel manufacturer, either in payment of royalty or limiting of purchasing power, will be effected.

must be removed. This may be accomplished by selective flotation, but this cleaning process not only adds to the operating costs but invariably means a lower extraction. In other words, any refining operation, whether it be in concentration or in the electric furnace production of ferro, is necessarily a costly one. Neither copper nor iron interferes in the production of calcium molybdate, so that the need of either of these refining operations is entirely eliminated. It therefore becomes unnecessary for the miner to make a high-grade concentrate or to separate therefrom any of the copper or iron sulphides that might be contained. The millman will readily appreciate the saving that may thus be effected.

The production of calcium molybdate offers a further advantage in that the equipment for its manufacture does not involve great cost nor is especial skill required in the operation. The method is comparable to the cyanide process in that large tonnages may be readily treated and in many cases such may be carried out right at the mine. The electric-furnace production of ferro not only requires very large expenditures for tonnage treatment, but also necessitates particular experience and skill. Only in rare cases is the mining company in position to carry out such an operation, and it thus becomes dependent on some metallurgical concern to put its product into marketable form.

Calcium molybdate is readily made, and with high recovery, from all molybdenum ores by simple chemical treatment. The salt as usually furnished carries approximately 40 per cent metallic molybdenum and contains no impurities detrimental to good steel manufacture. It has been proved beyond question that molybdenum, in this form, is a very efficient addition agent for the introduction of the metal into steel.

The particular advantage of the process is that a carbon-free molybdenum addition agent may be afforded to the steel manufacturer at a price which will assuredly permit the competition of the metal with those at present in more general use. It is not within the scope of this article to attempt to point out the use or benefits of molybdenum in steel. The value of alloy steel in general is constantly becoming better appreciated. In the writer's opinion, molybdenum is the only metal commercially available in this country which is capable of developing in steels properties equivalent to those produced by metals which must now be imported. A possible strategic value exists in the ample and constant domestic supply of molybdenum that is now assured. From the results of the work that is being done by concerns, as well as individuals of prominence, it is certain that molybdenum will shortly fill an important place in the alloy steel industry.

Los Angeles, Cal.

Radium Scarcity

Owing to the scarcity of radium—which is now priced at $78,000 a gram—and the failure to discover new sources of supply, it is feared the shortage will become exceedingly acute. In the meantime, it is reported that radium for use in medical research is being prepared by a special method. A weak solution is made which gives off radium emanations; these, which are detected only by delicate instruments, are collected in tiny sealed glass vials and the vials are sent to medical men. It is stated that the efficacy of such bottled emanations lasts one week.

World Production of Coal in 1919

The world's production of coal in 1919 seems to have dropped back to the level of 1910. Preliminary estimates, necessarily rough, place the total output of all kinds of coal in 1919 at 1,170,000,000 metric tons, or 1,290,000,000 net tons. This is 162,000,000 metric tons less than the production in 1918, the last year of the World War, and about 171,000,000 tons less than that of 1913, the year before the war began.

This estimate is based by the Geological Survey upon reports to the Supreme Economic Council from countries which contribute about 85 per cent of the world's output. Obviously, returns from the other countries may materially alter this figure; if anything, they will probably reduce it still further.

The following table shows the estimated production of the world for each year from 1910 to 1919. Because of disturbances and interruptions in the compilations of Government statistics, particularly in central and eastern Europe, the figures since 1913 are not to be regarded as final. The metric ton of 2,205 lb. is used because it is the prevailing unit in non-English speaking countries. Americans will remember it most easily as being roughly equivalent to the gross ton and the English ton.

WORLD'S PRODUCTION OF COAL 1910-1919
(Metric Tons of 2,205 lb.)

Year	Production, in Part Estimated	Per Cent Produced by U. S.	Year	Production, in Part Estimated	Per Cent Produced by U. S.
1910	1,160,000,000	39.2	1915	1,190,000,000	40.5
1911	1,189,000,000	37.9	1916	1,270,000,000	42.1
1912	1,249,000,000	38.8	1917	1,336,000,000	44.2
1913	1,341,000,000	38.5	1918	1,332,000,000	46.2
1914	1,208,000,000	38.5	1919	1,170,000,000	42.1

Comparative production in five of the belligerent countries before and after the war is shown in the following table:

PRODUCTION OF COAL IN CERTAIN COUNTRIES, 1913 AND 1919
(In Millions of Metric Tons)

	1913	1919
United Kingdom	292	237
France (present boundaries)*a*	44	22
Belgium	23	18
Germany (present boundaries)*b*:		
Bituminous	173	109
Lignite	87	94
United States	517	494

(*a*) Includes Alsace-Lorraine. (*b*) Excludes Alsace-Lorraine and the Saar.

It is pointed out by the Supreme Economic Council that from 1913 to 1919 the output of bituminous coal in the four European countries shown in the table has fallen from 532,000,000 to 386,000,000, the decrease being about 20 per cent in the United Kingdom and Belgium, and nearly 40 per cent in Germany. In the Saar Valley, whose output appears to have fallen from 12,000,000 tons in 1913 to about 8,000,000 in 1919, the percentage of decrease was over 30. The reduction in the French output is mainly due to the destruction of the mines in the Nord and Pas de Calais.

The output of lignite in Germany in 1919, though less than in 1918, was still greater than before the war, being 94,000,000 tons, as compared with 87,000,000 in 1913.

In the break-up of Austria-Hungary the bulk of that country's coal and lignite, the production of which amounted before the war to about 55,000,000 tons, was inherited by the Republic of Czechoslovakia. The 1919 production of Czechoslovakia was about one-third less than the same territory produced in 1913.

The Fertilizer Situation

A Statement of the Present Tendencies of the Fertilizer Industry—Fewer Brands—Thermal Phosphoric Acid Processes—Theory of Fertilizer Use—Solution Method of Applying Concentrated Fertilizer Salts

By MILTON WHITNEY

TO ANYONE who has given careful thought to the fertilizer situation for the past few years, especially since 1913, there is evidence of a profound change taking place not only in the methods of sale but in the fundamental methods of manufacture. It has been long recognized that the old trade or brand names have outlived their usefulness with the organization of capital and the merging of small interests into great enterprises. With the advent of the European war and the consequent shortage of material and uncertainties as to supplies, it was realized that many of these brands could not be maintained, and they were merged into uniform grades without material effect upon the volume of the trade in commercial fertilizers. The advantages they were supposed to give competitors handling comparatively small amounts of material were found to be a liability of the larger concern because of the increased cost of manufacture, printing and distribution. From one point of view they may have served a useful purpose, but that day is now past, and they must be discarded. From another point of view they were detrimental in that they retarded to some extent the passage of the fertilizer trade into the real chemical industry that it is destined to become.

Conservation of Phosphate

Even before the war emphasized the limitations of rail transportation and the necessity for greater conservation than in the past, it was recognized that the enormous losses entailed in the mining and marketing of the large annual output of Florida and Tennessee phosphates made it of the utmost importance that some adequate scheme be devised to conserve our phosphate deposits. Practically all of the rock mined at present is converted into superphosphate by treatment with sulphuric acid. The acid phosphate manufacturers demand a rock notably free from iron, alumina and calcium carbonate. As a consequence it has been estimated that for every ton of rock that is converted into the superphosphate by treatment with sulphuric acid two tons are discarded as unsuitable for such treatment. The Bureau of Soils is at present conducting investigations which it is hoped will lead to the development of a method by which phosphoric acid may be profitably obtained from this discarded material. It is worthless so far as sulphuric acid treatment is concerned. Its only salvation lies in another method. If the Bureau of Soils plan succeeds, it will mean the conservation of by far the greater part of our phosphate deposits.

The fusion of a mixture of phosphate rock, sand and coke in an electric furnace permits the volatilization and subsequent collection by the Cottrell precipitator of phosphoric acid of satisfactory purity and concentration. If water power could be obtained around $6 per hp.-yr., this method would be adapted to commercial production, but at the present price, $20 to $25, the cost of production of phosphoric acid by the electric furnace is about three-quarters of a cent higher than by sulphuric acid treatment. Moreover, it is not likely that water power will ever be available in large quantity at a price sufficiently low to warrant its use in the production of phosphoric acid, which must be sold on the ton basis, when there is such a large and rapidly increasing demand for power by producers of the more expensive chemicals sold on the pound basis. Recent work in which oil fuel is used as the heating agent, instead of the electric furnace, gives promise of a commercial method for preparing phosphoric acid.

Advantages and Disadvantages of Phosphoric Acid

There are certain advantages and certain disadvantages in the use of phosphoric acid. One of the disadvantages is the difficulty attending the transportation of a corrosive liquid. However, this can be readily overcome by converting the acid into one of its soluble solid salts, as will be shown later. Some of the advantages are that it can be produced at the mine from mine-run material, since the presence of impurities which offer objections in the case of sulphuric acid treatment are actually necessary for successful furnace treatment. If the rock is high grade, sand must be added to displace the phosphoric acid. The presence of relatively large percentages of alumina, instead of being a drawback, greatly facilitates the smelting of the phosphate charge. The mine-run material, therefore, is generally more suitable for fusion work than high-grade rock.

It seems best to convert the phosphoric acid thus produced into a solid salt by neutralizing it with ammonia or potash. The substitution of these bases for lime saves a considerable part of the freight and provides a soluble product which does not revert to an insoluble compound, as is the case with acid calcium phosphate. While the saving of the rock which is now thrown on the dump was the primary cause of the investigation which is being conducted by the Bureau of Soils, it now develops that the fusion process will have other advantages in that several of the products from the nitrogen-fixation plants can be freely mixed with ammonium or potassium phosphate, which cannot be mixed with the acid calcium phosphate without reversion of the latter and decomposition of the fixed-nitrogen product.

The fertilizer industry of the past has been largely a scavenger industry, using materials that were formerly waste products, some of which were even detrimental to health. One of the first of these products to go into commercial fertilizers was cotton seed and cottonseed meal, then the fish scrap, an offal from the fish houses, then animal tankage and refuse from the slaughter houses.

Unlike European practice, where fertilizer constituents are generally applied singly from time to time, the American practice has been to use mixed fertilizers and make only one application. A theoretically ideal mixed fertilizer must contain three representatives of nature's nitrogen cycle, phosphoric acid and potash. Nitrate nitrogen is immediately available for plant use and nourishes it in the very earliest stages of growth, while the nitrogen of ammonium salts becomes available only after it has been oxidized to the nitrate condition by processes that take place slowly in the soil; hence a supply of nitrogen is furnished the plant at a later period of its growth. The third representative of the nitrogen cycle above referred to is the so-called organic ammoniate or protein body. These bodies must undergo still more complex changes, requiring a correspondingly longer period of time. The soil must first convert the protein into an ammonium compound, then oxidize the ammonium salt to nitrite and finally to nitrate before the nitrogen can be taken up by the plant. In the time required for this transformation, the plant has probably reached the last stages of its development.

Organic Ammoniates for Feeds

Some years ago it was found that some of the organic ammoniates used for fertilizers could be used as concentrated feeds for animals. As a result of the European war and the efforts made to increase animal production, these organic ammoniates have gone more and more into feeding purposes. Up to the beginning of the war, the price of the organic ammoniates was controlled in a way by the world price of nitrogen in nitrate of soda.

In October, 1919, the department called a conference of producers of tankage, dried blood, fish scrap and cottonseed meal in order to ascertain why the price of nitrogen in these forms had not followed the drop in the price of nitrogen in nitrate of soda and ammonium sulphate. It was very clearly shown at that conference that changes of great magnitude had been going on and that the bulk of these materials is now being used for feeding purposes, and that their price per ton was regulated not by the price of nitrate of soda but by the price of other feeding stuffs. Today the competition between feeders and fertilizer manufacturers for these organic ammoniates is very great and is the subject of frequent comment in the trade journals. The cost of nitrogen is fully twice as great in the organic ammoniates as in mineral compounds. Judged by fertilizer standards, cottonseed meal at $80 a ton has become a luxury, while from the feeding standpoint, comparing its protein content with other feeds, its price is low as a feeding material. It is unlikely, therefore, that the price will decline materially or that the farmers will stand for the fertilizer manufacturers bidding for material against the feeders.

Increasing Scarcity of Organic Ammoniates a Source of Concern

The increasing scarcity, not to speak of the high prices, of organic ammoniates for fertilizers has been a source of real concern to the fertilizer manufacturer, for not only are these ammoniates in great demand as a source of nitrogen to make up their ideal of mixed fertilizer, but they are also depended upon to give the finished goods the proper mechanical texture. In the South generally cottonseed meal has been used as a conditioner; in the North tankage, fish scrap and dried blood. Mixtures consisting of ammonium salts, potassium salts and acid phosphate are likely to cake and harden in the bags and hence are not as easy of application as when mixed with organic matter. What to use as a conditioner is beginning to be a real problem. Dried ground peat is one of the natural materials that suggests itself as a substitute, but it is just as expensive to prepare peat as it is to dry and grind tankage. The value of peat is mainly as a conditioner, while tankage, cottonseed meal and fish scrap have an intrinsic value in their available nitrogen content.

Dependence of Nitrogen Supply on Other Industries

It seems rather illogical to depend so largely for our nitrogen supply upon the amount of cotton grown, the number of animals slaughtered or the quantity of fish caught, when it is well known that these have been limiting factors in the manufacture of fertilizers and have been always wholly inadequate to the needs of the country in order to fertilize properly such staple crops as wheat and corn. The use of fertilizer is advancing westward year by year and the demand for it will certainly increase much more rapidly than waste products can be made available, even if these were not being converted into feeds, but with this conversion the situation is serious in the extreme. Some realized before the war that we should have to come to fixed-nitrogen products. Few realize now that these fixed-nitrogen products are essential to maintain and to increase our crop yields by the extensive use of fertilizers. The developments of the war in the production of munitions have shown the lines along which this fixed-nitrogen problem is likely to be worked out and the commercial practicability.

Fixed-Nitrogen Products as Fertilizers

There are two main products that have heretofore been made on a large scale for munitions which can be utilized for fertilizer purposes. Calcium cyanamide is probably the cheapest form of fixed nitrogen, but this product is not entirely satisfactory. It can be used only in small quantity in our mixed fertilizers because it reverts the acid phosphate, and has in addition certain disadvantages in direct application to the soil. While some of the disadvantages of this material may be overcome, it has not been received with universal favor in Europe, where it has been longest used. The American farmers would have to change their methods of applying fertilizers in order to use a material which cannot be safely mixed with other fertilizer ingredient.

The other product of the nitrogen-fixation plants is ammonia. Ammonia may be oxidized to nitric acid and applied to the soil in the form of a salt of this acid, or the ammonia may be neutralized with sulphuric or phosphoric or nitric acid and used in the form of ammonium sulphate, phosphate or nitrate. Ammonium sulphate is well known in American agriculture at the present time, it being a byproduct of the coke industry. Ammonium nitrate is a new product to American agriculture. It is a much more concentrated form of nitrogen than ammonium sulphate, and it, therefore, carries a smaller cost per unit of nitrogen for transportation. On the other hand, it is highly deliquescent and has the further disadvantage that it can be mixed in only small amounts with other fertilizer ingredients, as in larger amounts it reverts the phosphoric acid and there

is a loss of nitrogen. Ammonium phosphate is equally new to American agriculture and is a highly concentrated fertilizer material.

Use of Fixed-Nitrogen Products

This leads to a consideration of how to use these fixed-nitrogen products. It has been shown that if phosphoric acid is abstracted from the rock there is economy in freight and in conservation of our phosphate deposits. Ammonium phosphate prepared by mixing ammonia from the nitrogen-fixation plant with phosphoric acid produced at the mine may be mixed in any proportion with ammonium nitrate, and if to this combination potassium phosphate be added, a mixture is obtained which is apparently not deliquescent, which does not undergo chemical change and which is the most concentrated form that it is possible to make a fertilizer and in which every constituent pays its own transportation charges. It contains two forms of nitrogen, but the third form—organic nitrogen—is missing.

When these stable salts of dipotassium phosphate, monoammonium phosphate and ammonium nitrate are mixed in the proportion to give a fertilizer of the formula 2-8-2—2 per cent nitrogen, 8 per cent phosphoric acid (P_2O_5) and 2 per cent potash (K_2O)—the mixture is so concentrated that it would require only only 326.4 lb. of the combined salts to make a ton, making it necessary to use 1,674.6 lb. of filler if it is to be diluted to the usual strength of the fertilizer of that composition. It could, however, be used in its concentrated form. A mixed fertilizer having the formula 4-8-4 would require 75.91 per cent filler to give the dilution in an ordinary fertilizer of that composition. A mixed fertilizer of 4-8-10 would require 69.6 per cent filler and one of 10-8-4 would require 58.76 per cent filler to give the usual dilution.

Method of Application of Concentrated Chemical Fertilizer

These mixtures are all completely soluble in water. They could be applied to the soil in the concentrated form of crystals, just as nitrate of soda is applied or as acid phosphate is applied. If it is desirable to maintain the degree of dilution in ordinary fertilizers, they could be locally mixed with peat or any similar substances in the proportion above given. The one filler that costs nothing and is readily accessible to all is water. In other words, the fertilizers could be dissolved in water and spread on the surface or applied in the drill. This would of course involve some change in farm implements, but not a very serious one. It seems to the writer that it would be of great advantage to the intelligent farmer to be able to obtain the separate ingredients, and by dissolving them separately in water and then mixing the resulting concentrated aqueous solutions in proper proportions to obtain a complete fertilizer of any desired composition. There would be the further advantage of uniform distribution and immediate and thorough incorporation in the soil.

Objection may be made that the solutions of the fertilizer salts would be too concentrated for ordinary application. An alternative method would be the mixing of such a solution with a definite amount of soil or sand and distributing this mixture in the same way as fertilizers are ordinarily distributed at present. This would not involve the use of any new machinery or any change in the present methods of agriculture. As an illustration, a complete fertilizer of the composition 4-8-4 would be made up as follows: Weigh out 148 lb. of K_2HPO_4, 161 lb. of $NH_4H_2PO_4$ and 173 lb. NH_4NO_3 and dissolve them in 182 gal. of water.

The advantages and disadvantages of such fertilizers may be summed up as follows: It must be admitted that the absence of the organic ammoniates is a distinct disadvantage in that it takes away a material that supplies the plant with nitrogen during the last stages of its development. On the other hand, the saving of freight and drayage, the more thorough mixing with the soil at the time of application and the ease with which subsequent applications can be made to the growing crop, either of the entire formula or any part of it as desired, are all advantages.

Preparation of Dipotassium Phosphate

Mention has been made of the proposed use of dipotassium phosphate in these mixtures as the most concentrated salt of potash in mixed fertilizers. This raises the practical question of the commercial preparation of such a salt from materials available. It has been established by numerous experiments that if potash shales are mixed with phosphate rock and coke, the shale taking the place of sand that is ordinarily added, the fusion takes place equally well and that part of the potash is volatilized and caught in the Cottrell precipitator as a monopotassium phosphate. The experiments have not proceeded far enough to indicate whether the evacuation of the phosphoric acid is as complete with the shale as with the sand, but there seems to be a possibility of collecting the two materials in one and the same operation. The monopotassium phosphate should be converted into the dipotassium phosphate to increase the percentage of potash in the salt and also on account of the greater stability of the latter salt. The conversion could be readily effected by mixing the monopotassium phosphate with potassium carbonate, which is now produced in considerable quantities from some of the deposits in this country. The most common salt of potassium used in this country for fertilizer purposes is the chloride. Potassium chloride mixed in the proper proportion with phosphoric acid and the mixture heated would yield dipotassium phosphate, and hydrochloric acid would be evolved. Hydrochloric acid is of considerable commercial value, and its sale would probably pay for the energy expended in converting.

Summary

This review of the fertilizer situation is not intended as exhaustive. Space does not permit the tabulation of figures, and perhaps they are not necessary. The statements made and the illustrations used will have served their purpose if attention is drawn to the fact that the fertilizer industry of today and of the future is bound to be a chemical industry based upon chemical investigations and control, instead of the scavenger and rather vague industry of the past, and if we come to realize that the time has arrived when we must meet the situation in a somewhat different point of view from that which has prevailed. The fertilizer industry has passed through the trying period of the war, and it has emerged upon a stronger and much more substantial basis than it had before the war. Changes must occur. It was foreseen that they must occur. The result has been to bring them more prominently before us and to establish the industry on a still more substantial basis.

Instruction in Iron and Steel at M. I. T.

By Carle R. Hayward

THE course which is described here is that required of students taking the metallurgical option in the department of mining and metallurgy at the Massachusetts Institute of Technology. Other students with adequate preparation may take the course if they desire. In addition to the field covered in this course the students receive instruction in iron and steel analysis in the chemical department, testing materials in the mechanical department and a thorough course in metallography and heat treatment which give them a knowledge of the chemical, mechanical and physical properties of iron and steel.

In a recent reorganization of the course some new features were introduced which have increased the interest of the students and at the same time given them a more thorough grounding in the subject.

Changes Made to Meet Criticism

The first of these changes was to meet a criticism, often heard, that the tendency in college work is to give the students "spoon feeding" in lecture courses instead of throwing them on their own resources. The lectures were accordingly cut to twenty hours, with an additional twenty hours allowed for preparation. It is obvious that only basic principles can be pointed out in this time and references given to the literature for details.

The time set free from class-room work is used in the library. The students are directed in their reading by assigning references to the files of technical journals or standard treatises on the different phases of iron and steel operations. In order to assure a thorough search of the literature five subjects are assigned on which concise summaries are to be prepared. The subjects of these papers may vary in different terms. Those used by the last class were as follows: 1. Blast-furnace construction. 2. The chemistry of the blast furnace. 3. The chemistry of the open-hearth processes. 4. Piping and segregation in ingots and castings. 5. The production of malleable castings and case-hardened steel.

It has been found that the students have taken a great interest in this part of the work and the net results have been very satisfactory. The library is used as never before and a familiarity cultivated with standard works and periodicals.

Neighboring Plants Visited

Another feature of the course which has proved both profitable and beneficial is the visiting of such plants as are available about Boston. These visits are part of the required work and each student writes a report of the trip. After the reports are completed the class meets to discuss the various operations and clear up any obscure points. The management of the different plants, realizing that these visits are part of the required work of the course, have heartily co-operated in this plan, which has contributed much to its success.

Although there are no iron blast furnaces in the vicinity of Boston, it is possible to study open-hearth practice and steel rolling at the American Steel & Wire Co.'s plant at Worcester, steel foundry work with open-hearth and electric furnaces, together with forging and heat treatment, at the Watertown Arsenal and other operations such as Tropenas converter practice, cast iron practice in cupolas and air furnaces, drop forging, etc., in various plants.

During the summer some of the men get positions in well-known steel plants, where they get practical experience which is valuable either before or after taking the course.

It is too early to judge the final results of this plan of teaching, but the indications are that the variety of instruction gets and holds the interest of the students and sends them out better equipped to meet actual plant conditions than does a course consisting more largely of lecture or class room work.

Cambridge, Mass.

Growth of the Artificial Silk Industry

Artificial silk, which a few years ago was looked upon as a novelty which provoked smiles in the trade, is growing continually in favor and has become a recognized part of the silk industry. Mr. Monges, a clerk in the American Consulate at Lyons, has compiled some history and statistics on the subject. The world's production of artificial silk was 2,000,000 kilos (about 4,420,000 lb.) in 1902, and the figures increased to 8,000,000 (about 17,680,000 lb.) in 1914. Germany is said to be producing about 5,000 kilos (about 11,000 lb.) daily, and France will be producing about 4,000 kilos (about 8,800 lb.) daily when her machinery has been put in order. The total production for 1919 is not given, but it is well known to have been far below the demand.

It was in 1885 that Audemars, of Lausanne, Switzerland, filed a patent on a vegetable fiber for use in incandescent lamps. In 1884 Comte de Chardonnet discovered the collodion thread which he aspired to place alongside of silk in the textile world. But not until 1895 was it possible for the company which he founded to put on the market a thread which was denitrated and consequently less inflammable. Up to 1903 the new industry, interesting though it was, was not seriously regarded in the industrial world, but rather was considered in the light of an interesting novelty. In that year, however, the Société de la Viscose put on the market the artificial silk which until recently has been the last word in artificial textiles.

On account of the substance which it employs (wood), the new industry has been enabled to adapt itself to all climes and is today in full swing in Belgium, Switzerland, Hungary, Poland, Germany, Russia, Italy, Japan and the United States.

At Lyons a renewed impetus was given recently to the use of chemical textiles by the invention of an entirely new process, the product of which is called silk cellulose. This new form of cloth is claimed to possess a brilliancy comparable to that of silk schappe. It has a remarkable solidity and durability, a touch similar to that of silk, and it is impervious to water. A big factory for the production of the new textile is projected for the Lyons district.

There are five kinds of artificial silk—nitrated silks, collodion silks, the viscose silks, the acetate silks and the gelatine silks.

It is to be noted that the increasing activity of the artificial textile industry, instead of coming into competition with that of the natural silk, coincides with and supplements the growth of the latter. The difficulty experienced by natural silk weavers in providing sufficient material, together with the top prices the natural silk commands, furnishes proof that natural silk is more than ever in demand and has nothing to fear from what many be called a "distant" competitor.—*The Review*, April 1, 1920.

Physical Properties in Rolled Rifle Barrels

By F. L. Moister *

THE specifications for barrels for U. S. Rifle Model 1917 provide for steel of the following chemical and physical properties:

Carbon	0.45 to 0.55
Manganese	1.10 to 1.35
Silicon	0.20 to 0.30
Phosphorus (max.)	0.08
Sulphur (max.)	0.06
Elastic Limit, lb. per sq.in. (min.)	70,000
Tensile Strength, lb per sq. in. (min.)	100,000
Per Cent Elongation in 2 in. (min.)	15
Per Cent Reduction of Area (min.)	30

Barrels made by the Remington Arms Co. were rolled from a 1½-in. round billet and were not subjected to further heat treatment. It was therefore

FIG. 1. ROLLED GUN BARREL FOR MODEL 1917 MAGAZINE RIFLE

necessary to obtain the specified physical properties by rolling.

The steel rolled into barrels at ordinary temperatures of hot-working will have elastic limits of about 60,000 lb. The additional 10,000 lb. must be imparted by rolling at low temperatures, but not low enough to reduce the ductility below requirements. The rolling temperatures ranged from 1,200 deg. F. for the lower to 1,260 deg. F. for the highest carbons (650 to 680 deg. C.).

The rolls are designed to finish a barrel in eleven passes. The barrel is an eccentric product, large at the butt and small at the muzzle, but not having an even taper. The rolling reductions are shown in Fig. 1, and also in the accompanying table.

Section	Diameter In.	Area Sq. In.	Per Cent Reduction
Billet*	1.500	1.767	.....
A	1.400	1.539	12.8
B	1.400	1.539	12.8
C	1.300	1.410	20.2
D	1.060	.802	49.5
E	.982	.757	57.0
F	.905	.643	63.6
G	.878	.605	66.9
H	.850	.567	67.9
I	.800	.503	71.4
J	.750	.442	75.0

*Original billet 1½ in round, 9.70 to 10.27 in. long.

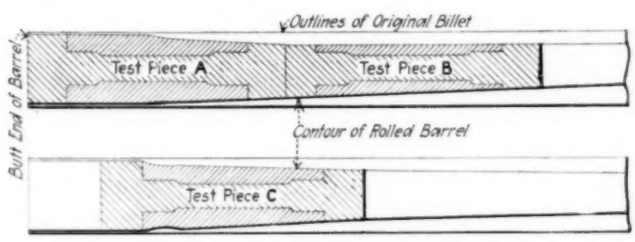

FIG. 2. LOCATION OF TEST PIECES

Consideration indicates that:

First, the finishing temperature varies in different parts of the barrel in proportion to the varying reductions in rolling.

Second, the physical characteristics of the steel vary in proportion to the variations in finishing temperature and reductions in rolling.

Third, the lowest elastic limit and tensile strength will be found in that portion in which rolling reductions are the least and in consequence the finishing temperatures the highest.

Ten billets from the same heat of steel were heated in the same furnace to 1,250 deg. F. (678 deg. C.) and were rolled into barrels on the same mill so as to equalize heating and rolling conditions as far as possible. The finishing temperatures were not determined, but the surface color indicated a range from about 1,000 at the butt to 850 at muzzle (540 to 450 deg. C.).

Three sets of five tensile tests each were taken from points in the barrel to represent the least, greatest and intermediate reductions numbered "A," "B" and "C." Series "A" had its center of gage length as near the extreme butt end as practicable, and series "B" adjoined "A" from same barrels. Series "C" was taken from five other barrels with 1½ in. discarded from butt. Test piece was then cut from as near the butt end as practicable.

Fig. 2 shows the location and methods of cutting these test bars.

Results of the tests, shown graphically in Fig. 3, follow the theory that as reductions increase and

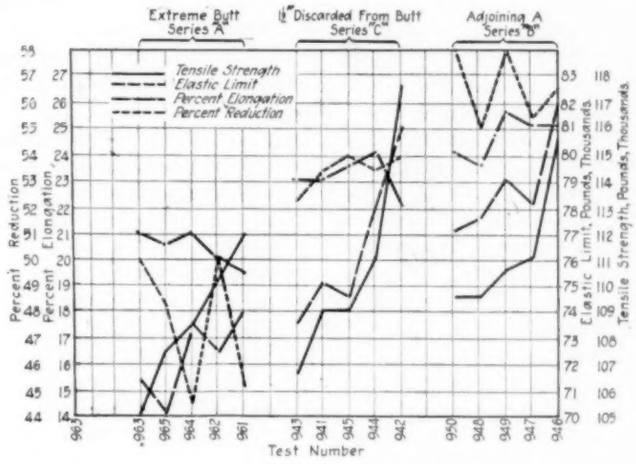
Extreme Butt Series "A"
1½" Discarded From Butt Series "C"
Adjoining A Series "B"
Tensile Strength
Elastic Limit
Percent Elongation
Percent Reduction
Percent Reduction
Percent Elongation
Elastic Limit, Pounds, Thousands
Tensile Strength, Pounds, Thousands
Test Number
963 963 965 964 962 961 943 941 945 944 942 950 948 949 947 946

FIG. 3. GRAPHIC REPRODUCTION OF TEST RESULTS

temperatures decrease the tensile strength and elastic limit are increased proportionately. Thus the lowest results were obtained in the "A" series, the highest results were obtained in the "B" series, and intermediate results were obtained in series "C."

Series "A" gets the least reduction in rolling and is finished at the highest temperatures; "B" gets the most reduction in rolling and is finished at lowest temperatures, while "C" gets intermediate reduction in rolling and finishing temperature.

The character of the fractures closely followed the difference in tensile strength. All "A" fractures were flat, slightly lipped, and showed faint radial lines. "B" fractures were semi-flat, and deeply lipped, with radial lines very pronounced. In one piece these lines extended entirely through the section like a split or seam. "C" fractures were semi-flat, lipped more than "A" but not as deep as "B," and the radial lines pronounced, but not as much as "B."

As the radial lines or fissures in all the tests become

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more pronounced as reductions in rolling increase and finishing temperatures decrease, this fact indicates that if the finishing temperatures should be carried low enough the structure would be completely broken down.

Radial lines invariably show in the fractured test piece if rupture occurs toward the muzzle end, i. e., the point of greatest reduction. They never show in the test of an annealed barrel. These radial lines are planes of weakness, produced by pressure in rolling at low temperatures, developed into visibility by pulling in the testing machine, but entirely removed by annealing.

The apparent loss in elongation in series "A" over "B" and "C" is due to fractures occurring outside the middle third of the gage length in all cases, invariably toward the butt pop mark, the weakest portion. In "B" and "C" fractures occurred in the middle third.

Tests were made on an Olsen 100,000-lb. testing machine, working with a speed of cross-head up to elastic limits equal to 0.048 in. per minute. Elastic limits were taken by a Berry strain gage.

The Magnesite Industry in 1919

THE production of magnesite in the United States in 1919 fell off about 30 per cent, but was nevertheless greater than in any year prior to 1917. F. McN. Hamilton, state mineralogist, estimates that California produced 42,000 tons of crude magnesite, or about one-half the production in 1918. According to R. W. Stone, of the U. S. Geological Survey, Department of the Interior, producers in the State of Washington shipped about 55,000 tons of dead-burned magnesite, which is equivalent to about 120,000 tons of crude magnesite, or 20 per cent less than in 1918. The output of crude magnesite in the country in 1919 was therefore about 162,000 tons. The material shipped from the State of Washington went to manufacturers of refractory wares and to steel mills east of Mississippi River, except about 500 tons that was distributed in Montana, Washington, California and Texas. About three-quarters of the California material was calcined and used in the plastic trade and the remainder was natural ferromagnesite used for making refractory materials.

Production Is Satisfactory

The large production indicated should be satisfactory and encouraging to the domestic producers, for even as late as June, 1919, it was expected that receipts of foreign magnesite would practically terminate the domestic industry. The imports, however, were not received as expected, and the demand for magnesite for refractory and plastic wares had to be supplied from domestic sources.

The Northwest Magnesite Co., of Chewelah, Wash., was the largest producer in the United States and made some shipments during each month in the year. Its shipments were smallest in May and June, but increased rather steadily to the end of the year, and are still large. The American Mineral Production Co., of Valley, Wash., sold its output crude to the Northwest Magnesite Co., whose quarries are near by. The Western Materials Co. took over the Double Eagle quarry, formerly operated by the Valley Magnesite Co., at Valley, Wash., and became a new producer in the state.

At the end of 1919 the principal producers in California were the Porterville Magnesite Co. and the Tulare Mining Co., at Porterville; the Western Magnesite Development Co., whose mine is on Red Mountain in Santa Clara County; and the White Rock mine, in Napa County. Smaller operations in California were in progress on the property of the Dinuba Magnesite Co., Tulare County; the Gustine Magnesite Co., Santa Clara County; Sinclair & Ferguson, Fresno County; and possibly one or two others.

Imports

The imports of magnesite in 1919, reported by the Bureau of Foreign and Domestic Commerce, comprised 6,381 short tons of crude magnesite, valued at $103,311, and 9,471 short tons of calcined magnesite, valued at $270,721, or a total value of $374,032. These imports came from the following countries:

	Short Tons	Value
Austria-Hungary	2,650	$64,933
Italy	2,416	62,753
Germany	34	2,023
England	29	4,849
Scotland	94	9,369
Canada	8,066	216,605
Mexico	2,563	13,500
	15,852	374,032

Presumably the material reported from Italy came originally from Austria-Hungary, and that from Mexico came from Santa Margarita Island and was calcined near San Diego. The imports in 1919, which amounted to less than 16,000 tons, were very small in comparison with those of former years. Grecian magnesite was not entered in 1919, and it is understood that none is likely to be imported for some time to come. The California magnesite must therefore continue to be used for the manufacture of Sorel cement, and as the value of this material for floors and for stucco on exterior walls becomes more widely recognized it would seem that some of the California deposits could be operated continuously and with profit. Unless the imports of magnesite suitable for making refractory material increase greatly, the domestic material suitable for refractory purposes —that is, the Washington magnesite and that from the White Rock mine in California—will continue to be used by domestic consumers, so that a fairly good year may be predicted for 1920.—*U. S. Geological Survey, Press Bulletin.*

India's 1919-20 Sugar Crop

The Indian Department of Statistics has issued its final memorandum on the sugar-cane crop of 1919-20, its figures being based on reports received from provinces containing 99 per cent of the total area under sugar cane in British India. Of the Indian states, estimates are furnished by Baroda and the states in Bombay Presidency. Estimates for the Orissa and Chota Nagpur Feudatory states have for the first time been received this year.

The total area shown is estimated at 2,667,000 acres, as against 2,884,000 acres in 1918-19, or a decrease of 7 per cent. The total yield of raw sugar (gur) is estimated at 3,001,000 tons, against 2,370,000 tons last year, or an increase of 27 per cent. The season has, on the whole, been favorable for the crop.

In addition to the areas for which particulars are given above, the crop is grown on a very small scale in certain other tracts in British India, the average area of which for the last five years has been about 25,000 acres, with an estimated production of 28,000 tons.

Manufacture of Potassium Permanganate

Generalizations With Details Obtained From Plant Operation — Chemistry of the Sodium Manganate Process — Dissolving and Chlorinating —Potash Crystallization — Research Possibilities

By RAYMOND B. STRINGFIELD*

DURING the war, several plants were constructed in southern California to supply the demand for permanganates, and the total tonnage produced was very considerable. No data, however, were available as to either scientific or operating details, and in consequence each plant had to work out its own salvation. Pressure of production necessarily greatly interfered with research, and cessation of hostilities, with the accompanying slump in the permanganate market, found many troubles still unsolved, and one by one the plants ceased operations. The interesting economic feature, however, is that no two plants had the same troubles, and had their combined knowledge been pooled the probabilities are that some if not all of the plants would still be operating profitably.

While potassium permanganate may be obtained in several different ways,[1] the sodium manganate process is the one which has been chiefly used in this country. The literature on the production of permanganate is scanty enough, and as practically no details of actual commercial operations have been published in English, it is hoped that the following notes taken from the author's experience with the industry in southern California will be welcome.

Chemistry of the Process

The sodium manganate process for the production of potassium permanganate may be divided into four main steps. Finely ground manganese ore and caustic soda, either with or without sodium nitrate as an oxidizer, are mixed and heated, either in a reverberatory furnace or a shallow iron pan, to form green sodium manganate.

$$MnO_2 + 2NaOH + O = Na_2MnO_4 + H_2O$$

This product is ground, dissolved in water, and the solution treated with chlorine and either sulphuric acid or carbon dioxide to convert the sodium manganate to sodium permanganate.

$$2Na_2MnO_4 + Cl_2 = 2NaMnO_4 + 2NaCl$$

If no chlorine is used, the reaction

$$3Na_2MnO_4 + 2H_2SO_4 = 2NaMnO_4 + 2Na_2SO_4 + MnO_2 + H_2O$$

takes place, with the formation of only two-thirds the possible amount of permanganate and the precipitation of manganese dioxide. With the use of chlorine, the function of sulphuric acid or carbon dioxide is chiefly to neutralize the excess caustic soda, reducing the alkalinity, thereby allowing the more complete reversion of the manganate to permanganate.

The sodium permanganate liquor is freed from any manganese "mud."

The liquor is evaporated until the bulk of other salts present have crystallized out. The theoretical amount of potassium salt is then added, and the solution allowed to cool, potassium permanganate crystallizing out.

$$NaMnO_4 + KCl = KMnO_4 + NaCl$$

In the following description, the operation is not strictly that of any one plant, but details are combined from several plants in southern California.

Furnaces

The most important step in the process for making permanganate is the furnace reaction. Using caustic soda, equilibrium is reached in the reaction at a lower percentage of manganate than when potash is used,[2] but a considerable excess of alkali is necessary in either case, and economic conditions in this country favor the use of soda. Impurities in the ore affect the process in several ways. The presence of a small quantity of iron in the ore is beneficial, the reaction going slightly further toward completion, the iron perhaps acting as an oxygen carrier. Silica and alumina are detrimental, passing into solution later as sodium silicate and aluminate, their subsequent removal being an occasional source of trouble.

Although it is probable that further development would have been the roasting of the charge in comparatively thin layers in mechanically rabbled furnaces at a temperature below fusion, and with only air oxidation, the furnace operated most successfully was a gas-fired reverberatory furnace of the type shown in Fig. 1, operating at 980 deg. C. This furnace was built double, a crew of two men per shift handling the mixing, loading, rabbling and unloading for both furnaces.

Incoming manganese ore was passed through a Blake crusher, and then through a Herman ball mill, using 3-in. iron balls, the 80-mesh product being sent to storage. On account of inadequate grinding facilities, ground caustic soda was purchased in barrels. Sodium nitrate was delivered in 200-lb. (90.7-kg.) sacks.

The manganese oxides, "mud," recovered from the process were air dried on a cement floor, and returned to be used in a fresh mix.

The standard batch consisted of 325 lb. caustic soda, 225 lb. sodium nitrate and 350 lb. manganese ore (147.5, 102.1 and 158.2 kg. respectively). This was mixed in a small concrete mixer and loaded into the furnace with wheelbarrows, through charge holes in the top. It was then spread out with long-handled rakes, made from 4 x 6-in. (10.2 x 15.25-cm.) steel plates on 1-in. pipe,

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[1]For electrolytic methods see Chem. & Met. Eng., vol. 20, p. 387, and vol. 21, p. 680 (1919).

[2]See the excellent work of Schlesinger, Mullinix and Popoff, *J. Ind. and Eng. Chem.*, vol. 11, pp. 317-323 (1919).

and as it fused was mixed frequently. When well fused, the mass was thoroughly stirred with compressed air by plunging a 1-in. (2.5-cm.) pipe on the end of an air hose into various parts of the charge. This was repeated just before the furnace was discharged, and had the effect of increasing the percentage of sodium manganate about 1.5 per cent, and of leaving the mass spongy and much easier to grind. The charge was withdrawn by raking through the side discharge holes into wheelbarrows, from which it was spread on a brick floor to cool before grinding. Under normal conditions, eight charges could be handled in one furnace in twenty-four hours, making sixteen for the double furnace. On the charge given above, the average recovery from the furnace as crude green sodium manganate was 72 per cent of the weight of the raw charge. The "green" averaged 25 per cent sodium manganate, which is comparable to Australian practice.[3]

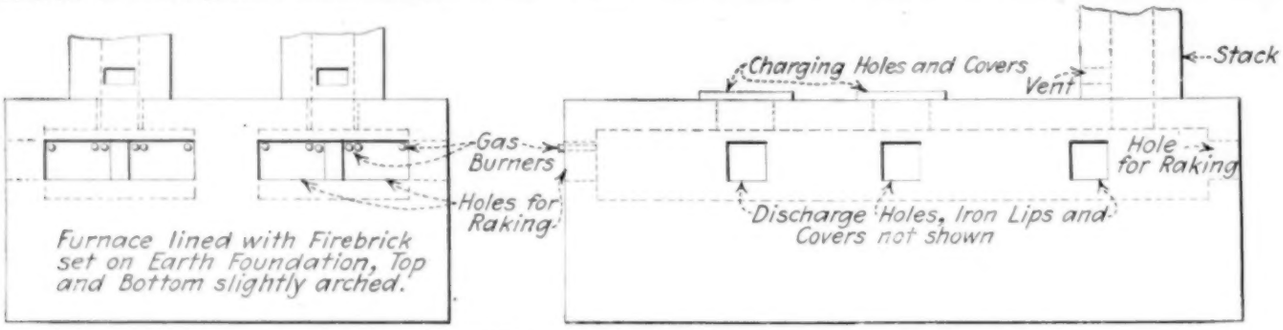
Charging Holes and Covers
Vent
Stack
Gas Burners
Holes for Raking
Hole for Raking
Discharge Holes, Iron Lips and Covers not shown
Furnace lined with Firebrick set on Earth Foundation, Top and Bottom slightly arched.

FIG. 1. FURNACE FOR SODIUM MANGANATE, 12 x 18 FT.

Under any operating conditions obtainable, the "green" was found to contain much sodium manganite, which decomposed on dissolving, throwing down a brown "mud," a mixture of manganese oxides. It was found that this "mud" could be air dried and worked into a fresh batch without lowering the quality of the "green." On account of the large amount of water in the "mud" it was not used alone, the mix being 325 lb. caustic soda, 200 lb. sodium nitrate, 250 lb. manganese ore, and 200 lb. air dried manganese "mud' (147.5, 90.7, 113.3 and 90.7 kg. respectively).

Dissolving and Chlorinating

The green manganate was passed through the same Blake crusher used for manganese ore, then through another Herman ball mill. The ground product was fed into a 700-gal. (2,650-l.) mechanically agitated dissolver, until the solution reached a specific gravity of 1.18, corresponding usually to the equivalent of 4.4 per cent $KMnO_4$. A greater density than this did not permit settling of the precipitated "mud." The liquor used for dissolving was the weak solution from the "mud" washing, carrying about 1.0 per cent $KMnO_4$. Into this dissolver, chlorine gas was run in the proportion of 1 lb. to every 4.45 lb. (0.45 to 2.01 kg.) $KMnO_4$ in solution, giving from 55 to 60 lb. (24.9 to 27.2 kg.) per batch. Two chlorine cylinders were mounted on platform scales and the gas introduced through several small holes in a pipe in the bottom of the dissolver. No trouble was had with the chlorine, except that the evaporation would cause cooling, and it was necessary in cold weather to turn the steam hose on the cylinders to melt off the ice, and increase the pressure of the chlorine.

From the dissolver, the muddy liquor was run either to a sulphating tank, Fig. 2, where strong sulphuric acid was added, or to a carbonation tower, where it was treated with carbon dioxide gas. In either case, the alkalinity of the solution was reduced to less than 1.0 per cent free NaOH, this point being easily controlled, with a little experience, by the color of the liquor, the green of the manganate changing to the full permanganate color at about 1.5 per cent alkalinity. The effect of the chlorine is apparently to form hypochlorite, which remains as such until the alkalinity is reduced, when it oxidizes the manganate to permanagate. The chlorinated liquor should be neutralized as soon as possible, and should not be exposed to the sunlight on account of the decomposition of hypochlorite and evolution of oxygen. The possibilities of electrolytic oxidation of the manganate in a suitab'y designed cell are very interesting.

The sulphated liquor was run to one of a series of four settling tanks, from which, after the mud had settled, it was decanted to a fifth tank, and the clear liquor from the top of this tank run over a weir to a "soda liquor storage." Both steel and concrete were found to be suitable for storage, little corrosion taking place as long as the liquor was alkaline, although the concrete was slowly affected. The mud was washed by counter-current decantation, and finally sent to the drying floor. This washing system could very profitably be replaced by a system of Dorr thickeners.

Evaporation

From storage, the "soda liquor" was pumped through a small measuring tank to open steel pans, where it was evaporated by means of steam coils immersed in the liquor, using steam at 60-lb. pressure (4.2 kg. per sq.cm.). As the solution became concentrated, the other salts present, being less soluble than sodium permanganate, were thrown down and were raked from the bottom of the kettles, centrifuged as dry as possible, washed with hot water, and sent to a salt dump. The handling of the salt is influenced considerably by the alkalinity of the liquor. When of proper alkalinity.

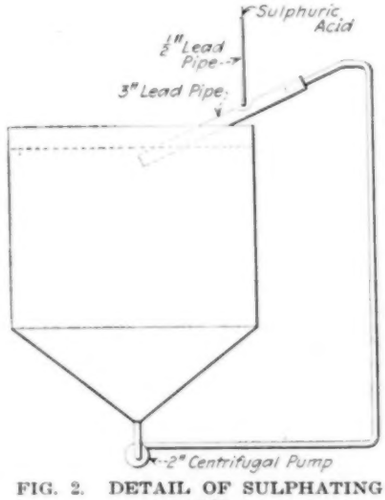

FIG. 2. DETAIL OF SULPHATING TANK

[3] See Met. & Chem. Eng., vol. 18, p. 546 (1918).

the salt comes down granular, does not scale the coils, and carries most of the silica and alumina in the solution with it. This is especially true when carbonated liquor is used, sulphated liquor carrying a much larger percentage of impurities in solution. If the liquor is excessively alkaline, the salt is very fine, and tends to form hard cakes in the centrifugals, making thorough washing very difficult. On the other hand, too low an alkalinity causes the formation of a hard scale on the coils. As the alkalinity increases, due to concentration, the tendency for the permanganate to revert to manganate increases, and above 5.0 per cent NaOH is liable to cause trouble, the probable equation being:

$$2NaMnO_4 + 2NaOH = 2Na_2MnO_4 + H_2O + O$$

The kettle men were taught to test their own samples by the procedure given later, and when the liquor reached a concentration equivalent to 14.0 per cent potassium permanganate, an amount of potassium sulphate or chloride equivalent to the permanganate present was placed in a wire basket and lowered into the boiling solution. This dissolved rapidly, and the

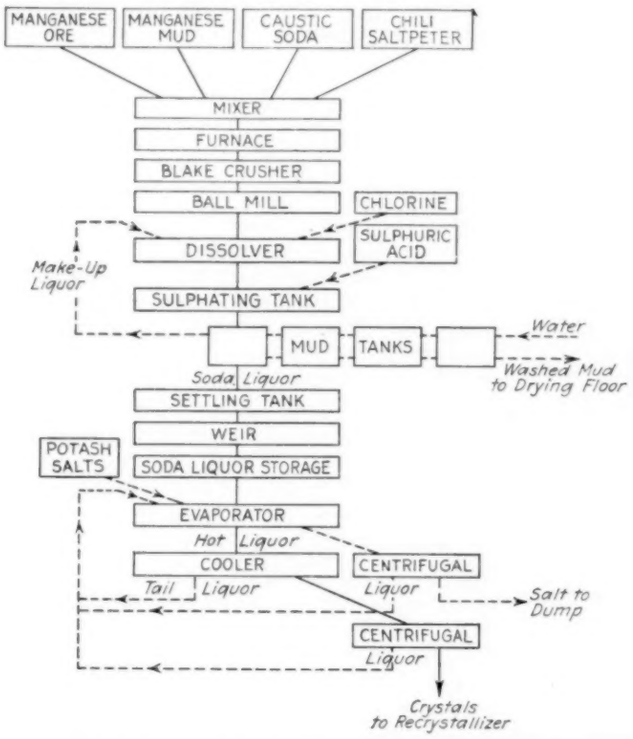

FIG. 3. FLOW SHEET, MANUFACTURE OF PERMANGANATE

solution was then drawn off to shallow iron coolers holding about 400 gal. each. These were supported so as to have free circulation of air, and cooled in four to six hours. After drawing off the cool mother liquor, the crystals were raked into a centrifugal, spun free of liquor, washed with cold water, recrystallized if necessary, dried on screens in a current of warm air, and packed in containers for shipping.

In connection with the crystallization, some interesting solubility effects are observed which deserve much further study. Various mixtures of chlorides, carbonates and sulphates are observed to repress the solubility of permanganate greatly, a mother liquor of 3.0 per cent being common, and 1.0 per cent not uncommon, against a normal solubility of potassium permanganate in pure water of 6.0 to 7.0 per cent. It should also be noted that the true color of potassium permanganate crystals is a brownish black. In former years, the trade has demanded purple crystals. The color was due to a film of decomposed permanganate on the surface. This was caused by the method of drying, and decreased the purity of the crystals 0.2 per cent or more. Most users have now become accustomed to the black crystals, and demand them as the purer product.

Laboratory Control

As mentioned before, a simple method was developed for the analysis of the ordinary permanganate liquors, and the kettle men were taught to make this determination on the soda liquor going to the kettle (to calculate the amount of potash to be added) and on the concentrated "hot liquor." This lessened the labor in the laboratory very materially, and made it possible to run it one shift only without delaying plant operations.

As several of the analytical methods used have not been published, a résumé of these may be of interest.

Permanganate. For purposes of comparison, all results, even on soda liquors, were expressed in terms of potassium permanganate.

On Liquors, Salts and Raw Crystals[1]—Ten c.c. N/10 $FeSO_4$, containing 10 per cent H_2SO_4, was titrated cold with a solution of the unknown permanganate, and results read from a table based on the following: For strong liquors, dilute 10 c.c. to 500 c.c. then

$$\text{per cent } KMnO_4 = \frac{158}{\text{c.c. titration}}$$

For weak liquors, salts and raw crystals, use larger or smaller quantities and correct the result accordingly.

On Green Manganate[1]—Dissolve 5 to 10 g. $NaHCO_3$ in 200 c.c. of water, add 5 g. finely ground manganate, stir until dissolved, dilute to 500 c.c., settle out MnO_2, and titrate with this solution as above. Multiply result from table by 3 to give total yield of permanganate obtainable with complete chlorination, since with this method three molecules of manganate give only two of permanaganate and one of manganese dioxide.

On Potassium Permanganate, U.S.P.—Dissolve 0.750 g. in 200 c.c. hot distilled water in a 400-c.c. beaker, add 5 c.c. 1:1 H_2SO_4, and pipette in very carefully 25 c.c. N oxalic acid. Stir until the MnO_2 formed is all dissolved, and titrate the excess oxalic acid with N/10 $KMnO_4$. At the same time, run a standard on 0.750 g. of potassium permanganate of known purity. This was prepared by recrystallizing U.S.P. potassium permanganate twice from distilled water, and drying in an air oven at 105 deg. C. On this product, water insoluble was determined on a 10-g. sample, and purity called 100.00 — $insol_w$ which was usually over 99.95 per cent. To calculate results, using a slide rule, let t_1 = back titration of standard, and t_2 = back titration of sample. Then purity of the sample =

$$\text{per cent standard} - \left(\frac{t_2 - t_1}{237}\right), \text{ i.e.}$$

$$99.95 - \left(\frac{14.3 - 13.0}{237}\right) = 99.95 - 0.55 = 99.40 \text{ per cent}$$

Duplicate determinations by this method check easily to 0.05 per cent, which is a much greater accuracy than can be obtained by the method of the U.S.P.

[1]Credit for this method belongs to R. W. Poindexter, Jr., of Poindexter & Co., whose suggestions were responsible for its development.

Alkalinity (Causticity due to NaOH).[5] On any strong liquor, dilute 25 c.c. sample to 250 c.c., and of this, take 10 c.c., decolorize with neutral H_2O_2 dropwise, filter with suction on an asbestos Gooch crucible, wash, keeping volume as low as possible, precipitate carbonates and sulphates with 10 c.c. of 10 per cent $BaCl_2$, filter, wash and titrate with N/4 HCl, 1 c.c. = 1.0 per cent NaOH. On weak liquors, H_2O_2 and $BaCl_2$ may be added in same solution and filtered together.

Research Work Needed

Several phases of this process present opportunities for interesting and commercially important research work. Much of this work requires equipment usually found only in a good university laboratory, and in case of an opportunity to engage in such work, the following suggestions are offered.

1. The effect of various proportions, temperatures, impurities and catalyzers on the furnace reaction between caustic soda and manganese ore.
2. Solubilities and phase rule diagrams for mixtures of the chlorides, sulphates, carbonates and permanganates of sodium and potassium.
3. The development of a suitable cell for the electrolytic oxidation of sodium manganate to permanganate.
4. Decomposition of permanganate solutions in the presence of MnO, MnO_2, etc.
5. Best conditions for the elimination of silica and alumina from permanganate solutions.
6. Conditions affecting the reversion of permanganates to manganates in alkaline solutions.

Summary

1. Details for the manufacture of potassium permanganate as carried on in southern California have been given, with analytical methods used in controlling the process.

2. A number of lines of research work are suggested.

Los Angeles, Cal.

[5] Since this method was developed, a similar method has been published by Craig, *J. Soc. Chem. Ind.*, vol. 38, pp. 96-7T (1919).

Wood Pulp Manufacture in Argentina

The utilization of the forestal riches of Misiones Territory, Argentina, for the manufacture of paper pulp is a suggestion that has met with favor among those interested in developing this industry in the country. Adequate means of water transportation is one of the especial advantages emphasized by Trade Commissioner Brady.

This territory, containing about 11,700 square miles, is in the extreme northwest of Argentina, lying between the Rivers Parana and Uruguay, which, in that region, average about fifty miles apart. Since the Parana is navigable for large steamers, water communication can be maintained with Buenos Aires, Montevideo and other ports. Misiones is tropical and heavily wooded, more than 700 varieties of trees having been counted; among these is an abundant tree, called caraguatazol, said to be very well suited for paper pulp.

Although the Territory of Misiones is sparsely settled, it is one of the sections to which immigrants are now turning. A holding, containing 416,800 acres, covered with heavy forests with an abundance of Araucanian pines 65 ft. high, was recently offered for sale at about $2 per acre.

Camphor Production in British Empire

The world's annual requirements and the present practical monopoly of production by Japan of camphor, together with the present high price and increasing demand, have drawn attention to the possibilities of profitable cultivation of camphor in other countries and particularly within the British Empire.

Prof. P. Carmody, F.I.C. (late Director of Agriculture, Trinidad), discusses the situation in the *Times Trade Supplement* of April 10. He points out that refined camphor is now about 2s. ($0.49) per oz. and 23s. 6d. ($5.72) per lb., whereas five years ago it was per pound little over the current price per ounce; and although there are—or have been—great fluctuations, the price may rise further unless increased production is assured.

Commercial camphor, he states, chiefly originates in Formosa, but as "the camphor is obtained there by distillation of the wood the annual destruction of trees must be very considerable, and this may account for the reports of diminishing supplies." It is estimated that 10,000,000 lb. of camphor is required by the world annually. Other present sources are the Fukien Province of China, Shikoku and Kiushiu Islands in Japan, Cochin China, Sumatra, Java and Borneo.

Results Already Obtained in British Colonies

In 1852 the tree was introduced into Ceylon, but little more was done until in 1893 a supply of seeds was obtained from Japan, and 1,000 trees were grown therefrom, from which, in 1901, the yield of solid camphor from fresh prunings was about 1½ per cent. "It is estimated," Prof. Carmody states, "that the yield of prunings (6 to 8 in. long) would amount to 56,000 lb. per acre per annum, and that with camphor at 2s. per lb. the net profit per acre per annum would amount to £74 ($360)." In 1906 there were over 100 acres devoted to camphor growing in Ceylon, but the cultivation was not commercially successful, as less than one ton of crude camphor was harvested.

At the present time experiments, with satisfactory distillation tests, are being carried out in the Federated Malay States, but in Mauritius the oil yielded is not the camphor of commerce.

In 1906, Prof. Carmody states, about fifty trees in Trinidad were transplanted to a better soil, with the result that "the growth has been quite satisfactory and a normal yield of solid camphor has been obtained on distillation," and in Dominica trees "obtained from Trinidad in 1911 have made satisfactory growth and have yielded solid camphor."

Requirements of Successful Cultivation

In the matter of successful cultivation, he advises that "seeds or seedlings from trees that yield no solid camphor must not be used. Stiff clay soils must be avoided. Not more than 300 trees to the acre should be grown in good average soil, or not less than 12 ft. apart in hedgerows, and a sufficient area (from 100 to 500 acres if possible) for economical distillation. When the trees are four or five years old they can be clipped, and thereafter three or four times a year."

Finally, he expresses the opinion that "the successful cultivation of camphor within the Empire is no longer doubtful," and "the reported depletion of native forests offers great inducements for further efforts," particularly in view of present high prices.

Apparatus for the Determination of the Porosity of Metals

By F. K. Bezzenberger and R. A. Wilkins*

IN THE making of non-ferrous castings for certain purposes, considerable importance is attached to the ability of the castings to hold pressure without leaking. Various tests are made to determine the applicability of a certain alloy or of a certain type of casting to the particular purpose in view. Such tests give isolated results, and offer no workable basis for a comparison of the porosities of various alloys when cast under the same conditions, or of the same alloy when cast by various methods.

An apparatus and method of testing are herein described, which not only afford a basis of comparison in any particular instance, but by which a numerical expression, denoting degree of porosity, can be assigned to any alloy under any conditions of casting. The advantages of such a method are great, not only in that the results obtained can be filed for future reference and comparison, but also because the basis of tests is standardized.

Apparatus

Fig. 1 shows the test casting use. This piece is cast oversize and machined so as to overcome the surface effect. It is of course necessary when comparing different alloys that the same method of casting the test piece be employed in each case, and when the effect of various types of casting is to be determined, that the alloy used and all other conditions be kept constant.

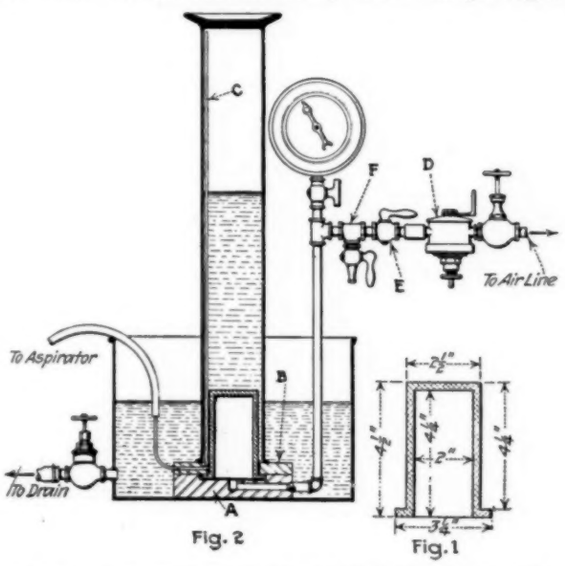

Fig. 2 Fig. 1

APPARATUS FOR THE DETERMINATION OF THE POROSITY OF METALS

Fig. 2 shows the testing apparatus, with the test piece in place. The "test cup" rests on a rubber gasket placed on the base, *A*. This base is made of steel and is drilled so that air may be admitted into the interior of the test piece. The flange, *B*, also made of steel, screws down on the base, holds the test cup in place, and gives an air-tight joint between the cup flange, the rubber gasket and the base. A 2,000-c.c. glass graduate is inverted over the test cup and over the small, rubber-tipped copper tube, *C*. The apparatus rests in a tank partially filled with water. Tube *C* is connected with an aspirator, and is used to remove the air from the graduate, which, of course, is replaced with water. Connections are made, as shown, to a constant-pressure air line. *D* is a reducer, by the use of which any desired pressure is maintained. The cock *E* admits air to the apparatus at the desired pressure. Cock *F* opens the system to the atmosphere, and is used to release the pressure instantly upon completion of the test. A pressure gage is placed in the air line, as shown, and a thermometer is hung in the water tank.

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Method of Testing

Testing procedure is as follows:

The test cup with gasket is placed in position on the base *A*. Flange *B* is then screwed down in place to give a tight joint, and the water tank is filled until the water level is about halfway up the test cup. Cock *E* is opened to test the apparatus for leaks, and the pressure gage is read. If necessary, the reducer is adjusted until the gage indicates the desired pressure. Air is then shut off and exhaust cock *F* opened until the pressure is reduced to atmospheric, and then closed. The glass graduate is then placed in position, and filled with water by means of an aspirator connected to the tube *C*. The apparatus is now ready for the test proper.

The cock *E* is opened at an observed time, and air, leaking through the casting, is collected in the graduate, When the volume of gas collected is sufficient to be read easily, the cock *E* is closed, cock *F* opened, and the time observed. These three operations should be simultaneous. It is well to collect 500 to 1,000 c.c. of air before stopping the test, as the relative error decreases as the volume increases. The difference in level between the water in the graduate and in the tank is measured, and the temperature of the water observed. The test is then complete, when the following data should have been taken:

1. Volume of gas collected.
2. Pressure of air used.
3. Difference in water levels.
4. Time of test.
5. Temperature of water.
6. Barometric pressure.

Calculation of Results

The measure of porosity, called *K*, is equal, numerically, to the number of c.c. of gas, under standard conditions, leaking through the standard test cup per minute per atmosphere of pressure, and is calculated from the formula:

$$K = V \times \frac{273}{Ta} \quad \frac{B - Vp - \frac{H}{13.6}}{760} \times \frac{1}{Tm \times Pa}$$

The literal quantities have the following meaning:

V = volume of gas collected, in c.c.
Ta = absolute temperature of water, in deg. C.
B = barometer, in mm. of mercury
Vp = vapor tension of water at observed temperature, in mm. Hg.
H = difference in water levels, in mm.
Tm = time of rest, in minutes
Pa = pressure used, in atmospheres.

The term Pa is introduced into the formula for the sake of simplifying the unit K. For comparative results, however, Pa should be maintained constant. The proportion $\frac{V}{V_1} = \frac{Pa}{Pa_1}$ although approximate, is not exact.

It is obvious that if so desired, the standard test cups be altered in design to permit of the study of the effect on porosity of thickness and of area exposed.

This apparatus and method of testing have been found very valuable in the study of the properties of various alloys. When castings are being made which are required to hold pressure, the incorporation of this porosity determination as a part of the standard testing practice gives data which are of great value in the maintenance of careful technical control.

Cleveland, Ohio.

Output and Shipments of Chilean Nitrate of Soda

The production of nitrate of soda in Chile during January, 1920, was 4,034,517 quintals of 101.4 lb. each and the exports were 9,039,403 quintals. The figures for the same month in 1919 were 4,276,498 quintals and 1,308,951 quintals, respectively. The exportation of 9,039,403 quintals, or about 409,000 long tons, was the largest in any one month in the history of the nitrate trade. It was brought about through the existence of fair stocks on the coast ready for shipment and the arrival of sufficient tonnage to load that quantity. It will not be possible to maintain shipments at that figure constantly owing to the inability of the railroads connecting the elaborating plants in the interior with the ports to transport that quantity regularly.

It is reported that the Asociacion de Productores del Salitre (Nitrate Producers' Association), which controls the sale of most of the nitrate produced, has recently received orders from Europe, and especially from Great Britain, for large quantities of nitrate for delivery before the end of 1920, the totals amounting to over a million tons. Prices are at present in the neighborhood of 15 shillings f.a.s.

The German steamers which were in Chilean ports during the war are being utilized to carry nitrate to Europe. Several have sailed, and three of those which had their machinery disabled are now being loaded with nitrate for Europe. These vessels are to be towed to destination by tugs sent out from Europe for that purpose. The use of the German steamers and sailing vessels will greatly facilitate the movement of the large quantities of nitrate which are now so urgently desired in Europe.

The large shipments of nitrate are reducing the stocks at the oficinas in the pampa, though there is still sufficient quantity to supply what is needed for exportation for several months. In view of the increased demand, five oficinas which were closed down for some time are preparing to start operation soon and are advertising for employees.

Forecast of India's 1919-20 Oilseed Crop

The March forecast of India's winter oilseed (rape, mustard and linseed) crop of the 1919-20 season places the area under rape and mustard at 3,563,000 acres, against 2,964,000 for 1918-19; and that under linseed at 2,323,000 acres, against 1,890,000 acres last year. The condition of this season's crops is, on the whole, considered good.

Legal Notes

By Wellington Gustin

The Chute Process for the Manufacture of Wood Alcohol Valid

In a recent suit for infringement instituted by Harry O. Chute against the Wisconsin Chemical Co., the action was based on claims 1, 5, 6 and 10 of the Chute patent, No. 824,906, for an improvement in the process of making wood alcohol, issued July 3, 1906.

These four claims of the patent are more or less typical of the six other claims of the patent, and are herewith given:

"1. The process of preparing wood alcohol from crude pyroligneous acid, which consists in distilling from said acid a concentrated distillate of between 10 and 25 per cent alcoholic content and of acid nature, allowing said distillate to stand to permit separation of impurities, and decanting off the clear liquid.

"1. The process of preparing wood alcohol from crude pyroligneous acid, which consists in distilling from said acid a concentrated distillate of between 10 and 25 per cent alcoholic content and of acid nature, allowing said distillate to stand to permit separation of impurities, decanting off the clear liquid, adding thereto an excess of alkali, decanting and refractionating the decanting liquid to produce perfectly miscible alcohol of above 80 per cent.

"6. The process of preparing wood alcohol from crude pyroligneous acid, which consists in distilling from acid an acid product of an alcoholic strength wherein oily impurities are insoluble, allowing the same to stand to permit separation of such impurities, and decanting off the clear liquid.

"10. The process of preparing wood alcohol from crude pyroligneous acid, which consists in distilling from such acid an acid product of an alcoholic strength wherein oily impurities are insoluble, allowing the same to stand to permit separation of such impurities, decanting off the clear liquid, adding an excess of alkali, decanting away from the resinous deposit formed, and refractionating the decanted liquid to form a strong alcohol of above 80 per cent and perfectly miscible with water."

Court Holds the Chute Patent Is Merely an Improvement of an Old Process

These claims were held valid and infringed in the United States District Court, and the chemical company attacked the decree of this court in its appeal, relying on alleged invalidity and non-infringement of the Chute patent. In passing on the questions involved, the United States Circuit Court of Appeals, Seventh Circuit, sets out Chute's method. The making of alcohol, it remarks, from wood was old in 1906, therefore the patent relates merely to an improvement of the process.

The pyroligneous acid is obtained from condensing the vapor or smoke from the burning wood to a liquid by means commonly practiced before 1906. This base is used in the Chute method. Chute's problem was to reduce the cost of producing the alcohol from this acid. It contains many ingredients, and it is by retain-

ing some and eliminating others that manufacturers are enabled to produce a merchantable wood alcohol, that is, an alcohol of at least 82 per cent strength and miscible with water. Chute claims to have reduced the cost by eliminating some of the steps previously taken. By his first step he obtained a distillate with a greater alcoholic strength than was formerly sought. By his third step he used an "excess of lime" to (*a*) neutralize the acid and (*b*) remove the resinous ingredient. He describes this step in his specification, as follows:

Practical Results Obtained by the Use of an Excess of Lime

"Therefore, after decanting the alcohol from the separated oily bodies, I add an excess of an alkali, as lime. Reaction soon sets in, as is shown by the development of yellow color, the familiar color known and carefully avoided in working with pyroligneous acid as an evidence of overliming. It is here, however, advantageous and not detrimental. As the reaction progresses, alkali-resinous matters separate and form a precipitate. These resinous bodies formed by the action of the alkali on the aldehydic and ketonic impurities form a mass of novel and useful characteristics, it being substantially a dye resin, being susceptible of use as a dyestuff, as it stains organic matters bright yellow when properly applied, and also of use as a resin. Being formed from a liquid from which the oily and tarry impurities have been removed by previous treatments, it is substantially pure. I do not claim this material herein specifically, but reserve the right to file a separate application therefor. The spirit decanted from this precipitate will be found much improved in quality, having been freed from these two classes of impurities, and I am therefore enabled to directly rectify in any rectifying continuous column, producing by this one redistillation alcohol of standard 82 per cent strength, but of such purity that it is miscible with water in all proportions and cannot be refractionated into portions 'milking' with water."

What Determines the Validity of a Process Patent

An older process in common use was first to free-treat the pyroligneous acid of tar (alcoholic content then being about 5 per cent) so that it might be thereafter neutralized with lime to make a merchantable acetate. By this method the producer was able to market not only wood alcohol (subsequently obtained) but a byproduct of wood alcohol. But repeated distillations were required before wood alcohol, miscible with water, was thus produced. Although Chute's process loses a valuable byproduct, it is an improvement in the art of making wood alcohol; the advance being in the lessened cost of production. But validity of the process, as a patentable invention, does not depend upon the question of whether the wood alcohol plus the value of the byproduct in combination is greater than the wood alcohol alone. These values may vary.

The validity of the process was attacked because of the prior art as disclosed in an article written by Vincent, a French chemist. In his first distillation, Vincent, using a multiple still, stopped "at the point where the methyl alcohol has all been distilled over." He also says, "A rich alcoholic liquid which abridges later operations is obtained." It was contended that this step is equivalent to the first step in Chute's claim 1, above given, "which consists in distilling from the said acid a concentrated distillate of between 10 and 25 per cent alcohol content and of acid nature." But the court held there was a difference between the Vincent and Chute processes. Vincent's description of his primary distillate failed to set forth the specific statement of the per cent of alcohol in the distillate, and it completely failed to provide for the elimination of oils from the acid distillate, and also failed to describe a process whereby wood alcohol of 82 per cent strength was obtainable by two distillations from a pyroligneous acid base. Even if the first step were fully disclosed by Vincent, anticipation of the process would not appear. For invention is recognized in this process not because of any one step alone, but because "a particular step" is taken in connection with other particular steps. The use of "an excess of lime" is important only as a step taken with and after the first step that resulted in "a distillation of between 10 and 25 per cent alcoholic content and of acid nature."

Now, the validity of a process patent containing several steps cannot be assailed by showing any one of the steps to be old. Even where all the steps are old, anticipation is not established, unless it further appears that the steps (old individually) were previously employed in relation to one another as disclosed in the patent the validity of which is disputed.

Validity of Chute Patent Affirmed

The chemical company further attacked the process patent, contending that the use of the words "excess of lime" in Chute's process is too indefinite and vague to apply. But Chute, while speaking to the public, was addressing himself primarily to those educated in the art under consideration. He was dealing with chemistry and to those familiar with the manufacture of wood alcohol. The court was of the opinion that such a class would have no misunderstanding from the use of the term and would experience no difficulty in following the directions given by Chute. Then the specifications of the process remove any doubt. The purpose of "over-liming," as well as its manifestations, clearly appears in the description, and one skilled in the art may follow the directions with comparative ease.

Therefore the validity of the Chute process was affirmed.

New British Dye

After experiments extending over a period of two years it is reported, says the American Chamber of Commerce in London, that the British Dyestuffs Corporation, Ltd., has now discovered at its Huddersfield laboratories the secret of manufacturing alizarine cyanine green dye on a commercial scale.

This green dye was first discovered in Germany at the works of Bayer & Co. in 1894, and was manufactured exclusively by Germany before the war. The exact chemical details were jealously guarded, and no information was given to chemical associations or allowed to appear in German technical journals.

The special characteristics of the dye are that when applied to wool, chromed or unchromed, fine green shades are produced which remain fast. Since the outbreak of the war, woolen manufacturers have not been able to produce varying shades with the fastness of this dye, which is used particularly for tweeds and ladies' dress goods.

The Vegetable-Oil Industry of Hull

FOR a number of years Hull has been known as one of the largest vegetable-oil centers in Europe. Prior to the war Hamburg, Germany, ranked first and Hull had to be content with second place; but during the war Hull so increased its plants and equipment that it is now without doubt the largest center in Europe and, it is thought, will easily retain the trade and position already established.

The industry was completely under government control until the end of March, 1919. This control was worked with the minimum of inconvenience and there were few complaints. The basis of priority allocations upon which the supplies of oil and cake products were distributed was:

1. The manufacture of edible oils, such as margarine and cooking fats.
2. Soap and candles.
3. Industrial uses, including the manufacture of paint, varnish, oilcloth and linoleum.

The greater part of the oil was used for culinary purposes. Linseed oil could be used for industrial consumption only on condition that it be "split" and the glycerine thus obtained delivered to the government.

The war greatly augmented the importance of the vegetable-oil industry owing to the increased demand for glycerine (for explosives), lubricating oil (castor oil for airplane motors), oil cake for cattle food, and oil for the manufacture of margarine. On account of the shortage of butter in the United Kingdom enormous quantities of margarine have been manufactured. Hull plants now turn out an average of ten tons per week, which is retailed at 26c. a lb., against the 98c. a lb. that is obtained for butter.

Imports and Exports

Prior to the war oil nuts from British West Africa were sent mainly to Holland and Germany for crushing. During the war the government requisitioned the entire output of British West Africa and Egypt, but, notwithstanding, the supply of raw material available did not equal the demand.

In tons the weight of the oilseeds imported in 1919 is 1,148,810, against 722,914 tons in 1918 and 1,229,472 tons in 1913, the increase over 1918 being largely due to heavy recipts of linseed, and the falling off as compared with 1913 being due to the smaller quantity of cotton seed received. Approximately three-fifths of the linseed came from the British East Indies in 1919 and practically all of the rest came from Argentina; 247,342 tons of cotton seed came from Egypt, as against 333,435 tons in 1918, and 170,601 tons from India against nil in 1918. Rapeseed and castor beans were practically all from India.

As already stated, oilseeds were controlled by the government until the end of March, 1919. While under control all material was sold at fixed prices, which were changed at intervals by the government, due notice being given. With de-control in view, the Ministry of Food during March made arrangements with the crushers throughout the United Kingdom to take over at fixed prices all stocks and commitments of seed lying in warehouses in different parts of the country. For a short period business was retarded, though such trade as was effected was done at maximum prices. From this time on prices were very flexible.

In addition to the large quantities of raw materials imported from other countries, the United Kingdom makes large purchases of foreign and unrefined vegetable oils, the imports for the past three years aggregating $33,619,642 for 1917, $56,410,494 for 1918 and $104,720,321 for 1919.

The oils and oilseeds imported into the United Kingdom are not all retained in the country for consumption or for manufacturing into commercial products. A certain proportion is reshipped in the form in which received, though such shipments are of minor importance when contrasted with the total imports. These re-exports in 1917-1919 amounted to $14,507,663 for 1917, $980,959 for 1918 and $15,141,466 for 1919.

With de-control came a quick revival of the export trade in British-made vegetable oils, shipments in 1919 being nearly seven times those of 1918. The outstanding feature of the year was the phenomenal gain made by pure linseed oil—$31,818,821.

Trade in Oilseed Cake

The imports of oilseed cake (unsweetened) into the United Kingdom for 1919, as compared with 1918 and 1917, were:

	1917		1918		1919	
Oilseed Cake	Tons	Value	Tons	Value	Tons	Value
Cotton seed	131,898	$10,184,616	2,719	$222,024	198,926	$19,527,303
Linseed	76,860	7,221,073	8,109	800,106	71,252	7,977,386
Rapeseed	616	44,850	.....	.....	190	19,466
Unenumerated	3,518	254,489	.....	.....	7,906	806,457
Total	212,892	$17,705,028	10,828	$1,022,130	278,274	$28,330,612

In 1918, for nearly the whole year, the importation of oilseed cake into the United Kingdom was prohibited in the interest of economy of shipping.

The exports of British-made oilseed cake in 1919 amounted to 5,099 tons, valued at $448,857. The exports in 1918 were only seventy tons, value $7,397; and in 1917, eighty-five tons, value $7,499. There were no re-exports of foreign or colonial cake.

Labor Conditions—Profits—Outlook for 1920

During 1919 labor conditions were anything but good. Although there were no strikes in any of the vegetable-oil mills, there was a general dissatisfaction on the part of the workers. Numerous strikes of dockers and a general strike of the railway employees lasting ten days caused great congestion upon the docks, and the crushers were a number of times practically without seed. Furthermore, they had enormous quantities of oilseed cake in their warehouses which buyers were unable to secure because of a shortage of barges and freight cars. Conditions are now practically normal.

During the first quarter of 1919, while the industry was under government control, the profit to the mills averaged 10 per cent. After control was removed there was considerable speculation, and, as before stated, prices soared. During this period and for the last half of the year profits averaged 25 per cent.

The outlook of the British vegetable-oil industry for 1920 is very promising. A new plant of enormous size, consisting of an extraction mill, chemical laboratory, deodorizing plant, refinery, and margarine, lard and soap factories, is erected by a local company. During January and February 596,939 gal. of linseed oil, valued at $999,770, was invoiced through the Hull consulate for shipment to the United States. Shipments promise to exceed this amount later in the year.

Experimental Briquetting Plant

Briquetting of Fuels and Ores Presents a Series of Problems Which Can Be Solved Satisfactorily Only in a Commercial Size Operating Plant—An Outline of the Briquetting Research Work in the General Briquetting Co.'s Experimental Plant

BY ALBERT L. STILLMAN

OF COURSE it will work—*in the laboratory!* What research man has not encountered skepticism expressed by emphasis on the last three words of the above comment?

It is the laboratory result multiplied in plant design and operation that makes industrial progress. It is not unusual to see an excellent product, painstakingly evolved by the research department, fail in commercial production, not from anybody's fault, but because some unforeseen quirk developed in quantity production.

The science of briquet manufacture, perhaps more than other chemical and metallurgical industries, has many problems still in the experimental or laboratory stage.

The science of briquet manufacture does not confine itself to the conversion of anthracite culm into merchantable fuel, although that problem has indeed held the center of the stage for years. Wherever and whenever a fine material is produced as an incident to operation—a fine material whose return to coarser size would be of benefit—a field is open to this most modern of sciences. Such problems are becoming increasingly numerous in these days of enforced economies. Wherever the blast furnace operates, whether on ferrous or non-ferrous reduction, fine ores and flue dust are a detriment, clogging the blast and slowing down operation. Wherever fuel is sized, whether anthracite or non-coking soft coal, the agglomeration of the fines into domestic size is highly desirable. Wherever a saw or planing mill is operated, the sawdust and planings present a conundrum for salvage. Wherever lathes, drill-presses or milling cutters are shaping metal product, a pile of fine metal turnings or millings develops whose disposition has heretofore proved vexatious to the melter. Fine metal, whether iron, brass, aluminum or what not, whether borings, spinnings, turnings or trimmings, suffers vaporization and oxidation loss in melting not sustained by heavy scrap, and the melting requires much more time and care.

PROGRESS OF BRIQUETTING

There is need for specialized research in briquetting. The field has become wide enough to constitute an engineering specialty. It cannot be said that anyone can at a glance advise a method for returning a low-value fine residue to a high-value larger size—still less the best method. Certain problems in the field are now adequately answered—that is, commercial equipment, thoroughly standardized, has been installed, and has made quantity production at a cost well below the selling figure of the briquetted product. The specific instances cover a wide field. The Ohio Metal Briquetting Co. of Cleveland, Ohio, is making 16 to 20 briquets of steel turnings per minute—the briquets running about 12 to 20 lb. each. The light steel is bought at the market price for machine shop turnings and sold at a premium over the market price for heavy melting steel. The product is bought for open-hearth melting, and the open-hearth operators cannot get enough of them. Anthracite coal fines are being briquetted at many plants; notably that of the Lehigh Coal & Navigation Co., Bamford, Pa. This plant was recently enlarged from 200 to 1,000 tons per day capacity. The Berwind Fuel Co. maintains a highly successful operation at Superior, Wis., where Pocahontas—bituminous—coal is pressed into briquets for the Northwest trade. In Buffalo the Wickwire Steel Co. has installed a large toggle press operating at a capacity of eight tons per hour to briquet the daily production of iron flue dust, while in another part of the city the Buffalo Slag Co. operates a similar layout to briquet the flue dust of the Buffalo Union Furnace.

These installations are mentioned to show the progress of the commercialization of briquetting processes to date. Summarized, we find hard and soft coal, blast-furnace flue dust, certain ores and the light scrap of steel and brass alloys are today being briquetted successfully on a commercial scale, while foreign practice shows in addition peat, lignites, sawdust and the light scrap of iron, aluminum and other metals. Indications are that these latter will shortly enter into commercial operation in the United States.

RESEARCH ON BRIQUETTING

Metallurgists and fuel experts conducting their own briquetting experiments have found a scant bibliography to help them and a paucity of available apparatus and experience. Industry has needed a research laboratory specializing in briquet manufacture for a long time. The General Briquetting Co., with all the European experience in the art readily available, none the less appreciated the necessity of such research to meet the special needs of this continent. A trained personnel, the primary requisite, was carefully acquired. A research laboratory was installed wherein pioneer work on many classes of material was done. This undertaking was simply a chemical and physical laboratory with appliances added for the purpose of experimentation in briquet making. Much of value was accomplished.

Foreign experience was confirmed and added to. New methods were devised successfully. But still no method was available for proving that laboratory results could be realized on a commercial scale. Moreover, in briquet manufacture probably more than in any other field the laboratory product is of superlative excellence. Whatever the material, a closely supervised preliminary treatment by hand, whether mixing, shredding or mastication, coupled with the painstaking molding and pressing on a laboratory hand press results in an ideal product difficult to reproduce commercially on a large

scale. This fact has been made use of by uninitiated and unscrupulous alike, in the production of high-class samples for use in the flotation of stock sales for briquetting plants. Especially has this been true in the coal game. Clearly a laboratory for research in this field should be equipped to demonstrate the feasibility of production on a commercial scale and that too by actual trial.

Briquet Questionnaire

The first and most important question of all in determining the possibility of briquetting any given substance is the difference in value between the briquets and material from which they were made. In the beginning

FIG. 1. INTERIOR OF LABORATORY

of research a definite answer is impossible until a reasonable quantity of briquets have been made, and their use demonstrated by consumption under existing conditions. For instance, it is well to know, if possible, the price per ton one can obtain for coal briquets as opposed to coal dust, before establishing a manufacturing plant. The other questions which a client of a briquetting engineer might ask and reasonably expect an answer are as follows:

1. Can this material be briquetted at all?
2. Can it be briquetted by pressure only, without the use of binder or catalytic agent?
3. If pressure only suffices, what pressure gives the best commercial briquet?
4. What shape and size briquet is best suited to the requirements?
5. If binder is necessary, what kind is most advisable and in what quantity?
6. If catalytic agent or accelerator[1] is necessary, what kind is most advisable and in what quantity?
7. What is the best method of admixing the binder or catalytic?
8. What other preliminary treatment such as grinding, heating, mixing, mastication or combinations of one and all of them will be advisable before the material goes to the press?
9. What type of press is best adapted to the purpose in hand?
10. What scale of operation would be most lucrative?
11. What methods should be adopted for most economical handling of briquetted material?
12. Under what conditions are the briquets to be consumed?
13. What will be the cost of a plant and its elements?
14. What will be the total cost per ton of briquets produced?

[1]By catalytic agent or accelerator is meant a reagent which while possessing in itself no binding or cementing power produces a chemical action in the material which results in cementation. The use of ferrous sulphate and other oxidizing agents in the briquetting of blast-furnace flue dust is a notable example.

Both Experimental and Operating Test Required

For some of these questions the answer can be found in a small laboratory; market condition, supply and demand answer some others without scientific investigation; but for the remainder, and especially for the points 8, 9, 11 and 14, a tonnage run under conditions closely approximating commercial is exceedingly desirable. How to obtain facilities for such "runs" in order to supplement laboratory results without excessive expense was the "meat" of the problem. The obvious answer was the installation of an operating plant making briquets of material whose commercial briquetting was already recognized as a market proposition, yet whose machinery was of sufficient variety to meet, at least approximately, any new requirement.

Accordingly the General Briquetting Co. established in New York City, together with a completely equipped research laboratory, an operating plant which divided its activities between coal briquets for the domestic market and the fabrication of brass and bronze turnings into briquets for remelting.

Briquetting Coal by the Dutch Process

For the manufacture of coal briquets, the method known as the Dutch process, made famous by its success at the Lehigh Coal & Navigation Co.'s plant, was adopted. Coal dust requires a binder. The binder used in this case is a heavy oil residuum of a melting point of 160 deg. F. It is melted and piped to a horizontal

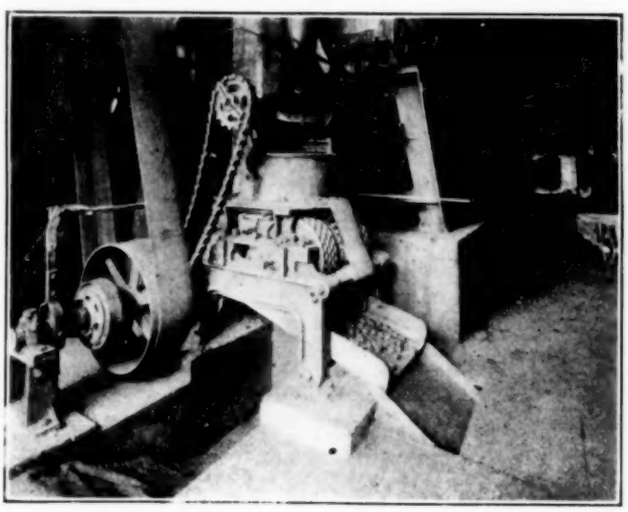


FIG. 2. COAL BRIQUETTING PRESS IN OPERATION

paddle mixer, there meeting a measured flow of dried coal dust, the ratio being about 95 per cent coal and about 5 per cent oil. From the mixer the coal oil flux drops into a great mill, known as the masticator, where heavy rollers grind the oil into the coal to a state, in fact, approaching dryness. From the masticator, the now thoroughly digested flux goes to a roll press, which molds it into 2-oz. eggettes, which are carried over a cooling conveyor to the bins.

The metal briquetting department is designed for the cleansing and briquetting of light brass scrap into clean briquets, 6 in. in diameter, 3 to 5 in. high—ingots in appearance and melting value. The waste metal trade of the East has long recognized the value of briquetted brass as opposed to loose turnings. Briefly, briquets of brass returned to the crucible show a marked decrease in volatilization and oxidation losses, a saving of a great percentage of melting time, and a consequent better control of melting mixtures.

The Vogel system of reclaiming metal, together with the large Ronay metal briquetting press, has been adopted.

In general this process involves the breaking up of the turnings in order that they may be fed to a press without choking the hopper; the removal of machine shop oil, whose presence impairs the strength of the finished briquet; and in the case of brass briquets, the removal of iron.

Installation of the Plant

Specifically at this plant, the installation consists of:

A Gilmore Shredder and Breaker wherein the turnings are broken up from long lengths to less than 5-in. lengths.

A Rockwell Rotary Furnace wherein the broken turnings are submitted to a temperature which has been determined as the proper temperature for burning out oil and waste without impairing the composition of the metal, or annealing the metal, for softening, where necessary.

A Cutler-Hammer Belt Magnetic Separator for the removal of iron filings, and in fact any ferrous admixture.

A Ronay three-stage vertical hydraulic metal briquetting press.

In addition a horizontal hydraulic press has been installed. The press is fulfilling a dual capacity. Where quantities of metal shipments are small and the vertical hydraulic press is at work on a large run, the horizontal hydraulic press works for the operating department, making metal briquets 4 in. in diameter and 3 to 4 in. high. The capacity is about 500 lb. per hour on such work, and the cost is, of course, higher than similar operation in the vertical press. Primarily, however, this press is a laboratory adjunct, and works on research material whenever indications point to a requirement for a pressure briquet approximately of the shape and size for which the mold is adapted. The working pressure can be varied from 3,000 to 20,000 lb. per sq.in.

Supplementing this small press the laboratory carries a small capacity edge runner or grinding mill for breaking or masticating material, and in addition a small rotating gas furnace for purifying purposes with a capacity of 200 lb. an hour.

Procedure of Investigations

Let us assume that this research laboratory is faced with three concrete problems—namely, the briquetting of materials marked A, B, C. Let us further presume that none of these materials has ever been briquetted at all. It is required to determine whether their briquetting could be accomplished with satisfactory commercial results.

The following procedure on the part of the laboratory is characteristic. As no previous experience in briquetting applies to these materials, one and all are tried on the laboratory hand press, using pressure only without admixture, to see whether or not a binder is required.

Let us suppose that material A is a fine metal and gives a good briquet in the hand press at 10,000-lb. pressure, material B, partaking of the nature of the fuel, gives no briquet under pressure without preliminary treatment or admixture, and material C, designated as a byproduct of chemical manufacturing, also fails to give a good briquet with pressure only. At this point the indications are as follows:

Material A. This material will readily make briquets along the approved commercial lines now adopted for metal briquetting. If the laboratory man has 30 or more pounds of this material at hand he makes a briquet on the horizontal hydraulic press. If more material is available, he makes a series of briquets showing results at varying pressures. A good briquet out of this press would show definitely that metal briquetting practice is adapted to the material at hand. When it is reported that the commercial briquetting of this material is possible, the trial is continued on carload quantities. When the carload has been made satisfactorily into briquets on either the vertical or horizontal press, the report furnished thereon, giving the time, power and labor required with the cost of the proper installation, indicates the solution of the problem for briquetting such material on a commercial basis.

Material B. This material presents a problem not quite so simple. The laboratory man tries all the various known commercial binders, still working with

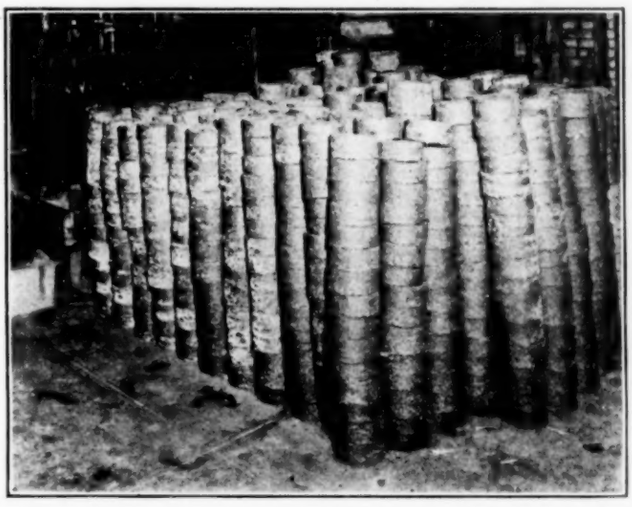


FIG. 3. BRIQUETTED TOBIN BRONZE TURNINGS

laboratory equipment and hand press to find out which binder is best. He further determines the proper treatment—grinding, heating, mastication or the combinations necessary to prepare the materials for pressing. In other words, the best way of mixing the material with its binder. After this mixture is completed short runs are made on the rotary press used in the coal plant turning out 2-oz. eggettes and comparison is made with the product under similar conditions in the horizontal press. If the economic report is satisfactory, work is continued on carload quantity in accordance with the method selected. The report in full on this run will give a correct basis for a commercial installation.

Material C. This material presents an interesting possibility. It is possible that the addition of a cata-

lyzer or accelerator may set up cementing action in the material so that it will bind under pressure. A series of known catalyzers are tried out and briquets made in the hand press. If an action takes place, the situation is probably similar to that of blast-furnace flue dust and the problem will parallel that of the Wickwire Steel Plant at Buffalo. There they briquet eight tons of flue dust an hour on a toggle press—pressure 8,000 lb. per sq.in.—the cementing action being caused by the addition of ½ of 1 per cent ferrous sulphate.

We may presume that one of these catalyzers or accelerators on Material C has shown a result similar to that produced by ferrous sulphate at Wickwire. In the hand press small runs are made by pressures varying from 1,000 to 20,000 lb. per sq.in. to ascertain at what pressure the cementation attains the highest efficiency. On the large Ronay press, as well as

FIG. 4. HORIZONTAL HYDRAULIC BRIQUET PRESS WORKING ON BRASS TURNINGS

the horizontal press, it is possible to vary the pressure within the same ranges. Consequently once the proper pressure is determined a tonnage run can be made in the plant at that pressure. In this case an allowance has to be made for the higher cost of hydraulic operation if the pressure indicated is low; that is, the tonnage run on a carload at the plant with a Ronay or horizontal press would cost more than a commercial installation using the toggle press. However, this deduction is easily ascertained from known practice in other places. The main answer has been obtained; that is, whether or not a merchantable briquet can be produced.

After-Treatment of Briquets

It frequently occurs that questions arise in regard to after-treatment for the purpose of toughening or hardening the briquets after they are produced. In some cases it is preferable, on account of low cost and smelting value, to use an addition of lime to secure binding effect. After-treatment is then often desirable to accelerate the setting of the lime. Such treatment is usually a heat either by direct steam or hot air. For such purposes a small hardening cylinder has been installed which can supply direct flue gas, live steam or super-heated steam to a charge of briquets in the cylinder. This installation has proved particularly useful in investigating the possibilities of ore briquetting.

Range of Usefulness of the Experimental Plant

The plant has already made a number of investigations, some of which are as follows:

Ground Phosphate. For the United States Department of Agriculture. Briquetted successfully in tonnage lots on the rotary press. Preliminary treatment: mastication with small percentage of water.

Carbonized Lignite. For the Lignite Utilization Board of the Dominion of Canada Government. Briquetted successfully in tonnage lots on the rotary press. Preliminary treatment: mixing and mastication with oil residuum binder.

Hard Steel. Briquetted successfully in Ronay press in tonnage lots. Preliminary treatment: annealing in rotary Rockwell furnace.

Hard Bronze. Same as Hard Steel.

Copper Cement. Briquetted successfully in horizontal press without preliminary treatment.

Tin Ore (Cassiterite). Briquetted successfully in roll press. Preliminary treatment: mastication with pitch binder.

Metal Leaf and Paper. Briquetted successfully on horizontal press. Preliminary treatment, low temperature heating in Rockwell furnace.

Complex Copper Ores. Briquetted in rotary press with lime binder. Preliminary treatment: mastication with lime. Final treatment: air-drying 24 hours or steam hardening in cylinder 3½ hours.

Shot Nickel. Briquetted in horizontal press. Preliminary treatment: mixing with sulphite pitch binder in pug mill.

Hardwood Sawdust. For Gas Defense Division, Signal Corps, U. S. A. Briquetted successfully in horizontal press without preliminary treatment.

There has been a host of other investigations, many whose result is still pending. The above serve to show how the supplementing of a laboratory with a commercial plant elastic enough to meet all reasonable requirements is not only desirable but very necessary in this important branch of research. In no other way can the "Fourteen Points of Briquetting" be adequately met.

English Dried-Flowers Industry

In consequence of the shortage during the war of medicinal herbs, an association of women in Suffolk, England, started systematic collection of such plants. From 1916 to 1918 belladonna, henbane and foxglove were the chief herbs handled.

During the year 1919 the demand for medicinal herbs fell off, but in their place arose a request for sweet-smelling herbs and flowers, and it is reported that during the current year collections thereof for the perfumery trade are being organized throughout the county of Suffolk. The new scheme is under the supervision of women botanical experts. It is stated that this rural industry has already resulted in considerable pecuniary benefit to East Anglian villagers, who have been instructed in the proper method of collecting. In April the picking of fresh heads of cowslips commenced, cowslips being used for sachets and pot-pourri as well as a cure for sleeplessness; broom and elder flowers will follow and many others.

A mill at Blackenham purchases the collections and prepares them for the market. The prices per pound at the mill for such dried flowers are: Cowslips (heads only), 2c.; broom flowers, 8c.; elder—heads, 1c., with florets picked off, 5c.; lime, 6c.; mullein and mallow, 8c.; bergamot (flowers without calyx), 12c.; lavender —on stalks, 12c., rubbed off stalks, 61c.; dark-red peony petals, 10c.; dark-red rose petals, 6c.; red field poppy petals, 8c.; mullein leaves, 2c.; raspberry leaves, 1c.; sage, mint, balm, agrimony and woodruff (whole herbs), 2c. Thyme brings 36c. per 14 lb.

Synopsis of Recent Chemical & Metallurgical Literature

Magnetic Properties of Iron Nickel.—In an effort to produce an alloy having higher saturation value than pure iron, for use in construction of electrical machinery, T. D. YENSEN of the Westinghouse E. & M. Co.'s research staff investigated the magnetic properties of very pure iron : nickel alloys made of electrolytic metal in an Arsem furnace.[1] Figs. 1, 2, 3 and 4 give the results of his investigation.

It has been shown by Honda[2] that the properties of the alloys in the neighborhood of 30 per cent nickel are very different after being cooled to liquid air temperature from what they are after being cooled merely to room temperature, and furthermore that this difference is due to the fact that these alloys—in addition to the reversible magnetic transformation points occurring above room temperature—have irreversible transformation points occurring below room temperature.

These transformations have been studied a great deal in recent years, the pioneers in the field being Hopkinson,[3] Le Chatelier,[4] Osmond,[5] Guillaume[6] and Dumas.[7] The alloys investigated by these scientists all contained foreign elements to some extent, particularly carbon and manganese. As a matter of fact, manganese was considered an essential constituent, because without it the alloys could not be forged. It is very unfortunate, however, for the interpretation of the results of the above investigations that these two elements referred to are the ones that affect the transmission points the most. Thus carbon is twenty times as effective as nickel in lowering the transformation points, and manganese, while less effective in this respect than is carbon, still is much more effective than nickel in specific influence. Fig. 5 shows Dumas' results for alloys without C and Mn, and in the region of 30 per cent both revers-

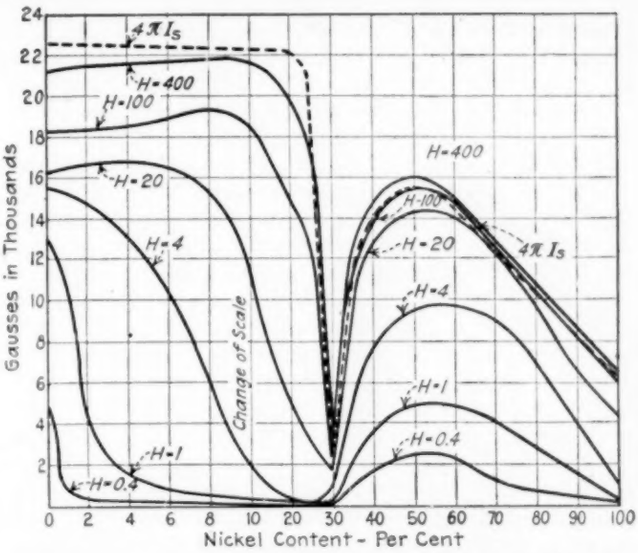


FIG. 1. SATURATION INTENSITY AND ISO-GILBERT CHARACTERISTICS

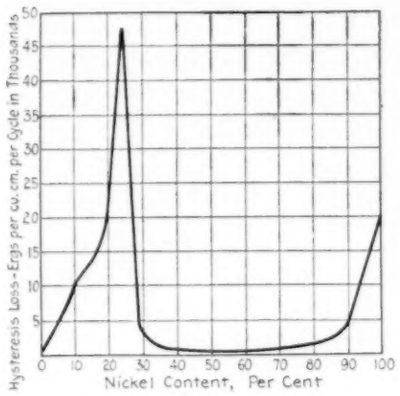


FIG. 2. HYSTERESIS LOSS

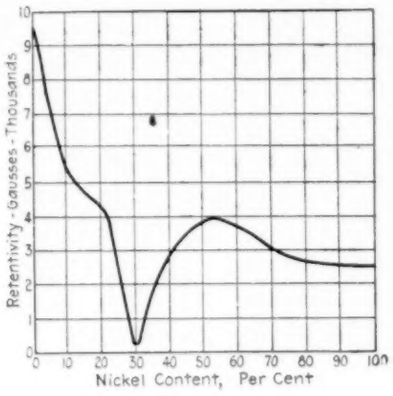


FIG. 3. RETENTIVITY

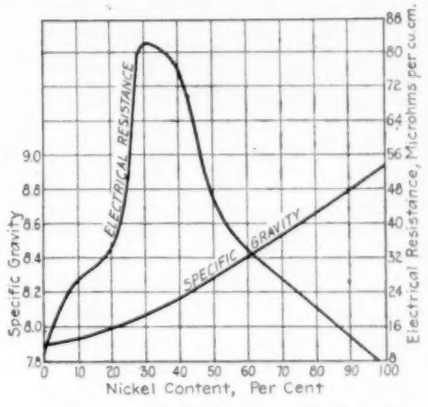


FIG. 4. ELECTRICAL RESISTANCE AND SPECIFIC GRAVITY

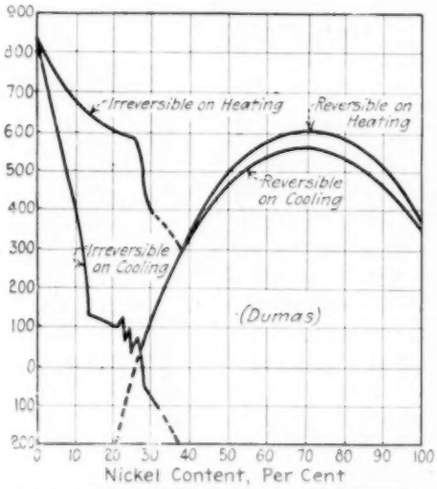


FIG. 5. REVERSIBLE TRANSFORMATIONS AS DETERMINED BY DUMAS' INVESTIGATION

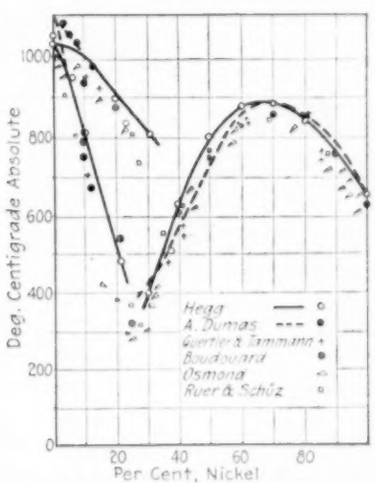


FIG. 6. REVERSIBLE TRANSFORMATIONS AS DETERMINED BY VARIOUS INVESTIGATORS

[1]Paper before joint meetings of American Institute of Electrical Engineers and American Electrochemical Society, Boston, Mass., April, 1920.

[2]The Thermal and Electrical Properties of Nickel Steels, "Science Reports," Tohoku Imp. University, vol. 7, p. 59 (1918).

[3]*Proc. Royal Soc.*, 46 and 47, p. 23, 1889; 48, p. 1, 1890.

[4]*Comptes Rendus*, 90, p. 285, 1890.

[5]*Comptes Rendus*, 118, p. 532, 1894; 121, p. 648, 1895; 128, pp. 306, 1395, 1513; 1899.

[6]*Comptes Rendus*, Jan. 25, April 5, June 18, July 26, 1897.

[7]*Comptes Rendus*, 139, p. 42, 1899; *J. Iron and Steel Inst.*, 11, p. 225.

ible and irreversible transformations were found; the latter, however, are lowered materially by a little C, which does not affect the location of the reversible points. Other investigations[a] are grouped in Fig. 6.

After quenching alloys in the 30 per cent region in liquid air, a remarkable change in magnetic properties at room temperatures ensues.

"Its saturation value was increased from 2,700 to 14,600 by cooling to —80 deg. and 17,800 by cooling to —180 deg. Similarly, the electrical resistance was decreased from 82 to 38 and to 32 by the above treatments. It is probable that the change would have gone to completion at —80 deg. if the test piece had been held there sufficiently long and that the irreversible transformation point therefore lies between 0 deg. and —80 deg., thus confirming Dumas' results.

"While only a few points were determined, they are sufficient to demonstrate that the cusp of both curves, after the completion of the transformations, occurs for approximately 34.5 per cent nickel instead of 30 per cent, as the previous investigation would lead one to believe. This points strongly toward the existence of the compond Fe_2Ni, corresponding to 34.6 per cent nickel, suggested by earlier investigators."

Recent Chemical & Metallurgical Patents

British Patents

Complete specifications of any British patent may be obtained by remitting 25c. to the Superintendent British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Citric Acid; Calcium Citrate.—Calcium citrate is purified by treatment with sulphur dioxide in the presence of water, the resulting solution of calcium bisulphite and citric acid being then boiled, after removing organic matter by filtration to drive off the sulphur dioxide and re-form the calcium citrate. The precipitated calcium citrate is filtered off, washed, and again subjected to the preceding treatment until sufficiently pure, when it may be decomposed with sulphuric acid to produce citric acid. The sulphur dioxide driven off is available for the treatment of further calcium citrate. When the raw material consists of lime-juice or lemon-juice, it is directly treated with calcium bisulphite, the subsequent treatment being as before (Br. Pat. 136,979—1919; H. D. GOLDING, J. RASCHEN and UNITED ALKALI Co., Liverpool; Feb. 18, 1920.)

Ammonium Perchlorate. — Ammonium perchlorate is obtained by double decomposition of ammonium sulphate and sodium perchlorate by a process which is stated to be generally applicable whenever one reaction product has a solubility increasing with temperature while the other has a solubility which rises to a maximum and then declines. An initial solution saturated with ammonium perchlorate and sodium sulphate at a temperature below 33 deg. C. is heated to a temperature above 33 deg. C. and ammonium sulphate and sodium perchlorate are added preferably in equivalent quantities so as to cause precipitation of sodium sulphate and saturation with ammonium perchlorate, the higher temperature being such that the ratio dissolved of sodium sulphate to water in the hot solution is the same as the ratio of sodium sulphate to water in the solution at starting. The precipitated sodium sulphate is removed and the solution is cooled to the starting temperature, when an equivalent amount of ammonium perchlorate separates, and the mother-liquor may be used again. It is not necessary for the starting solution to be wholly saturated with sodium sulphate, so long as the ratios above mentioned are equal, nor for the final solution to be wholly saturated with ammonium perchlorate, but these conditions give the best efficiency. An indifferent substance such as a small excess of one of the initial salts, or sulphuric acid, may be added once for all to the reaction mixture. In carrying out the process, the initial salts may be wholly or partly dissolved in separate portions of the initial solution, which portions are then mixed. (Br. Pat. 137,034—1919; L. M. E. WANG, Christiania; Feb. 18, 1920.)

[a]Bureau of Standards, Circular No. 58 (1916); "Invar and Related Nickel Steels."

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Solder.—There was, during the war, a demand for solders containing a minimum amount of tin, and cadmium was substituted in certain solders with more or less encouraging results. The higher melting point of these solders was to their disadvantage, but for certain uses solders with a relatively high melting point have certain applications where this property is desirable, such as, for example, soldering commutator leads in electric motors. GEORGE P. LUCKEY, of Wilkinsburg, Pa., has found that a solder containing 8½ per cent cadmium and 91½ per cent lead has a relatively high melting point, beginning to melt at 249 deg. C. and completely melting at 280 deg. C. Solder of this composition has a maximum breaking strength, approximately 3,600 lb. for ½-in. round butt-soldered joint. (1,333,666; March 16, 1920; assigned to the Westinghouse Electric & Manufacturing Co.)

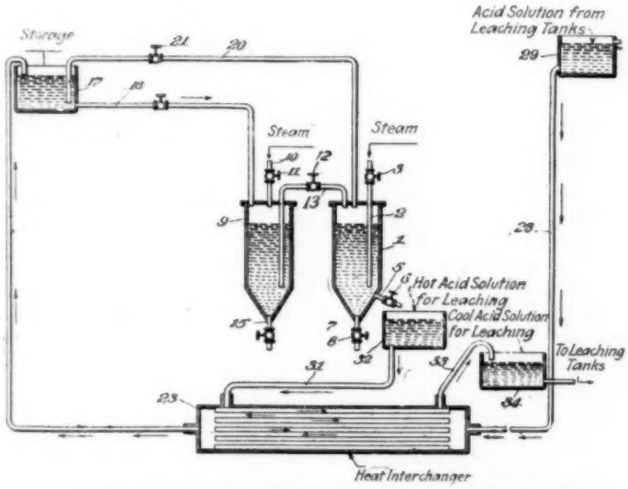
Purification of Zinc Solutions.—Nickel is one of the metals which produces deleterious results when sulphate solutions of zinc are electrolyzed for the recovery of zinc. In practice it is found that to obtain satisfactory results nickel must not be present in excess of one part per million. This element is not removed by the usual method, which consists in agitation with zinc dust at atmospheric temperature. SAMUEL FIELD of London, England, notes that in the presence of copper and at temperature of from 80 to 100 deg. C. zinc fume or blue powder will cause the precipitation of nickel, copper and cadmium and after removing the precipitate, the nickel content of the solution will be reduced to 0.5 part per million or less. (1,337,058; assigned to Metals Extraction Co., Ltd.; April 13, 1920.)

Process for the Extraction and Recovery of Tungsten.—The process consists in crushing the ore, preferably to pass a 120-mesh screen, leaching the comminuted ore with an alkali hydroxide such as caustic soda, filtering and washing the cake, and precipitating the tungsten from the filtrate by means of calcium chloride. Previous to filtering it is desirable to add acetic acid to give a slightly acid reaction to the solution. Suitable apparatus to carry out the process is described. (1,335,277; A. G. DE GOLYER of Ouray and A. E. RUND of Denver, Col.; March 20, 1920.)

Method of and Apparatus for Precipitating Copper From Hot Solutions.—When sulphuric acid is used to dissolve copper from ores or calcines, there usually is obtained a solution which contains iron sulphates. These, if the solution be electrolyzed for the recovery of copper, cause an increase in the amount of power consumed per unit of copper recovered. If the use of the solution be cyclic, the iron salts may accumulate to such an extent as to make uneconomical the continued use of the solution in this manner. Under these circumstances the copper is usually precipitated from the solution by means of iron and the liquor is wasted. This results in a loss of valuable acid. The expense of recovering all of the copper by precipitating on scrap iron is usually prohibitive.

FREDERICK LAIST, of Anaconda, Mont., proposes to precipitate the copper from hot solutions, using sulphur dioxide as the precipitant. It has previously been proposed to precipitate copper by impregnating the solution with sulphur dioxide and heating to a considerable temperature in a closed vessel. This process, while feasible, is not economical, due to the excessive cost of heating the dilute solution. It is desirable in using the process to heat the solution to a high temperature, since as a general rule the higher the temperature to which the solution is heated the greater the percentage of copper precipitated. The improvements proposed that result in a practical and economical process are in the conservation and utilization of the heat remaining in the solution from which the copper has been precipitated.

In the figure is illustrated, diagrammatically, apparatus suitable for carrying out the improved process. The



APPARATUS FOR PRECIPITATING COPPER FROM HOT SOLUTIONS

closed precipitating tank 1 has a steam supply pipe 2, extending into the solution as shown. Near the top of the conical bottom of the tank is a liquor outlet pipe 5. A pipe 7 is provided for the withdrawal of the precipitated metal. The closed preheater 9 has an inlet pipe 10 supplying steam to the upper part of the tank. A pipe 13 connects the upper part of the precipitating tank with the preheating tank, the outlet of the pipe being close to the bottom of tank 9, as shown. The tank is provided with a draw-off pipe 15. A closed storage tank 17 has an outlet (not shown) leading to an SO_2 compressor for the recovery of excess SO_2. This tank is connected near the bottom with the preheating tank 9, by means of a pipe 18. A pipe 20 connects the top of the precipitating tank 1 with the storage tank, the end of the pipe being near the bottom of the storage tank. Below the level of tanks 1 and 9 and the storage tank 17 is a tubular heat-interchanger, 23, of the countercurrent type. This is so designed that cold solution from the elevated tank 29 will flow through pipe 28 through tubes in the heat-interchanger and out through pipe 27 to the storage tank. Hot solution from the receptacle 32 flows through pipe 31 around the tubes in the heat-interchanger and out through pipe 33 to the receptacle 34.

The precipitating operation is carried out in the apparatus as follows:

The precipitating tank 1 is filled approximately three-fourths full of the copper-bearing solution from which the copper is to be precipitated, such solution being heated in the manner to be described to about 125 deg. C. From this temperature the heating to about 155 deg. C. is completed by admitting live steam from a boiler through valve 3. Prior to the treatment with live steam SO_2 has been added to the solution. The precipitation having been completed and a final temperature of 155 deg. C. having been attained, the valve 3 is closed and the valve 12 opened, thus releasing the pressure in tank 1 of about 100 lb. per sq.in. and causing the liquid to boil. The steam passes through pipe 13 into the solution contained in tank 9. In about 30 min. an equalization of pressure between tanks 9 and 1 is accomplished and also an approximate equalization of temperature results. What actually happens is that the pressure in tank 1 falls from about 100 lb. to about 30 lb. and the pressure in tank 9 rises from zero to about 30 lb., at the same time the temperature of the liquid in tank 1 falls from 155 deg. C. to about 130 deg. C. while the temperature in tank 9 rises from about 100 to 125 deg. C.

This having been accomplished, valve 12 is closed and valve 21 opened, permitting the steam to flow into the solution contained in tank 17, which has been raised within a few degrees of the boiling point by passage through the heat-interchanger. At the same time the acid liquor in tank 1 falls in temperature to about 100 deg. C. and is allowed to flow into the hot solution receptacle 32 by opening valve 6, whence it flows through the heat-interchanger to receptacle 34 and thence to the leaching plant. The copper which has been precipitated is drawn off by opening valve 8.

Valve 12 is now again opened and at the same time high-pressure steam is admitted through valve 11, forcing solution in tank 9 into tank 1 for treatment. Tank 9 is recharged with boiling solution from tank 17. The acid liquor which is received from the leaching vats into tank 29, in passing through the heat-exchanger, is heated from about 20 to about 90 deg. C. and delivered to tank 17 at this temperature.

In the manner described the process is economical and in certain circumstances to be preferred to the electrolytic method of recovering copper from solutions. The copper recovered is of wire-bar grade. (1,333,985; March 16, 1920.)

Preserving Hydrosulphite Solutions.—Solutions of hydrosulphites used in the indigo dyeing industry decompose rapidly. It is the usual practice to make up a fresh solution each day. PETER MACINTYRE of Clinton, Mass., has found that stock solutions may be kept for several weeks in tanks cooled with ice water. A layer of oil is poured on the surface of the solutions, forming an air-tight seal which prevents oxidation. (1,333,029; March 9, 1920.)

Current Events
in the Chemical and Metallurgical Industries

Sixth National Exposition of Chemical Industries

The National Exposition of Chemical Industries returns this year to the Grand Central Palace in New York, where it will be given during the week of Sept. 20 to 25.

This Exposition, which is the sixth, will be more pretentious this year than ever, there being now engaged space for 358 exhibitors, which is more than in the last Exposition, in Chicago. The growth of this Exposition is remarkable and in a way indicates the growth and development of the chemical industries in America. In 1915 the first Exposition was composed of 83 exhibitors, the second increased to 188, the third to 288, the fourth to 334, and in the fifth, in which the available space was much restricted, exhibitors were held to a minimum of 351. This year another floor has been obtained in the Grand Central Palace, giving four floors, so that exhibitors may not suffer the cramping felt in the last Exposition.

Increased Attendance and Interest

Quite as remarkable as the growth of the Exposition itself is the increased attendance and interest that is shown in the exhibits. To the first Exposition there came 63,000 visitors, to the second there came 80,000 and the number has steadily increased till at the last there were in excess of 111,000 visitors. One who has watched the development of the Exposition and the interest of the visitors can testify to the great improvement in character of representatives the manufacturers have in attendance with their exhibits. The visitors, too, have undergone a change—one of education. The first Exposition brought forth a small following of the idly curious, but in subsequent Expositions a study of those attending has developed the fact that the interest even of the general public is more vital.

Three Sections Planned

This year the Exposition will have three special sections—the Electric Furnace Section, the Fuel Economy Section and a Materials Handling Section. The two latter are new sections. The first will, as its name implies, be one of electric furnace exhibits; the Fuel Economy Section will consist of exhibits of machinery and apparatus, furnaces, producers, stokers and all devices for the economic utilization or more efficient combustion of fuel. The possible exhaustion of our fuel reserves in the not far distant future and the present high cost of fuel make this section of much interest to all industrial plants. The Materials Handling Section will be a series of exhibits of machinery and equipment for the handling of material such as conveying, transporting and elevating. Included in this will be weighing, measuring and power transmission equipment. So important have these mechanical features become for all industrial plants due to the shortage and high wage for man power that an unusual interest is expected in this new section.

The program for the Exposition will have sessions on subjects the phases of which will be developed in the exhibits of these latter two sections. There will be sessions on chemical engineering, for which an elaborate program is planned. Motion pictures will form part of the program, and there will be popular public addresses as well.

Code of Engineering Ethics

A proposed new code of ethics, prepared by a committee of mechanical engineers, but intended to serve as a basis for a code of principles for all engineers, was discussed at the semi-annual meeting of the American Society of Mechanical Engineers, held in St. Louis, May 24 to 27.

The essential feature of the code is its brevity. It is intended to be a brief, positive statement of the professional relations of engineers to the public, to their clients or employers, and to one another.

The committee formulating the code recommended the establishment of a standing committee on professional conduct to interpret it, and also to judge cases of questionable ethical conduct on the part of engineers.

Proposed Code of Ethics

1. The mechanical engineer should be guided in all his relations by the highest principles of honor, of fidelity to his client, and of loyalty to his country.
2. His first duty is to serve the public with his specialized skill. In promoting the welfare of society as a whole he advances his own best interests, as well as those of the whole engineering profession.
3. He should consider the protection of his client's or employer's interests in professional matters his essential obligation, provided these interests do not conflict with the public welfare.
4. He shall refrain from associating himself or continuing to be associated with any enterprise of questionable or illegitimate character.
5. He can honorably accept compensation, financial or otherwise, from only one interested party unless all parties have agreed to his recompense from other interested parties.
6. He must inform his clients of any business connections, interests or circumstances, such as might influence his judgment or the quality of his services to his clients.
7. He must not receive, directly or indirectly, any royalty, gratuity or commission on any patented article or process used in the work upon which he is retained without the consent of his clients or employers.
8. He should satisfy himself before taking over the work of another consulting engineer that good and sufficient reasons exist for making the change.
9. He must base all reports and expert testimony on facts or upon theories founded only on sound engineering principles and experience.
10. He must not regard as his own any information which is not common knowledge or public property, but which he obtained confidentially from a client or while engaged as an employee. He is, however, justified in using such data or information in his own private practice as forming part of his professional experience.
11. He should do everything in his power to prevent sensational, exaggerated or unwarranted statements about engineering work being made through the public press. First descriptions of new inventions, processes, etc., for publication should be furnished only to the engineering societies or to the technical press.
12. He should not advertise in an undignified, sensational or misleading manner, or offer commissions for professional work, or otherwise improperly solicit it.

Nitrate Distribution

Charges being made on the floor of the House that the War Department is putting all possible obstacles in the way of the distribution of a portion of its nitrate reserve for fertilizing purposes were denied categorically by Major J. H. Hunter, who is in charge of the distribution. To set up the machinery to handle the distribution of this material, he states, has required a few days, but every effort has been made to expedite the work.

Since only twenty-four requests have reached the War Department for this fertilizer since the passage of the bill permitting its distribution, it is anticipated that there will be no demand for the entire 100,000 tons for the distribution of which authority has been granted. It is feared that the season has advanced so far that the demand for fertilizer will not be great, although it is pointed out that Chilean nitrate can be used to particular advantage for a considerable period as a top dressing.

Faraday Society Receives Thanks for Its Assistance During the War

At the last meeting of the Faraday Society the president, Sir Robert Hadfield, made public the important part the society had taken in 1916 and 1917 in the movement which led to the formation of the Nitrogen Products Committee. The occasion of the announcement was the receipt of a letter of thanks from Sir Graham Greene, Secretary of the Ministry of Munitions, acknowledging the assistance received from the society and many of its members.

The letter states that arrangements are now on the point of being concluded whereby the synthetic ammonia factory which had been partially erected is to be transformed into a commercial project on a very large scale, and many other fixation schemes are under consideration throughout the Empire. It concludes that the Faraday Society will doubtless consider the objects it had in view, in bringing the nitrogen problem before the Ministry, have been in a great measure achieved.—*The Engineer*, April 23, 1920.

Government Oil Corporation Proposed

Carrying still further the semi-governmental corporation idea, Senator Phelan of California has proposed in a bill the formation of the United States Oil Corporation to develop oil resources in foreign countries. Control of the concern is to be in the hands of nine directors to be appointed by the President. The corporation "may explore, develop, refine, transport and store petroleum and its products." It may form subsidiary corporations and may solicit subscriptions of stock. The majority of the stock must be owned by American citizens, but foreigners may become minority stockholders. Reports as to the activities of the company may be demanded from time to time.

E. I. du Pont de Nemours Buys Varnish Plant

Announcement has been made that E. I. du Pont de Nemours & Co. and the Flint Varnish Co., of Michigan, have purchased the Chicago Varnish Co., of Chicago, Ill. No radical change of organization is contemplated. W. J. Schlinger, vice-president and general manager of the Flint company, will have charge of the two plants.

Phosphate Deposits for Lease

Secretary Payne has approved rules and regulations for the leasing of phosphate deposits in the public lands. About 2,500,000 acres of lands in Wyoming, Idaho, Utah and Montana have been withdrawn from disposition for a number of years awaiting legislation recently enacted by Congress. These regulations will open them to lease in areas not exceeding 2,560 acres each and should add largely to the fertilizer supply of the United States, phosphate forming an important ingredient in commercial fertilizers. Applications for leases are to be filed with the local land offices for transmission to the Secretary of the Interior, and printed copies of the rules and regulations will be available to those officers and to the public as soon as printed.

Status of Paper Makers' Strike

Leaders of Unity of Workers, an independent organization of paper makers, on strike for 70c. per hour, express themselves as being satisfied with the results of the strike so far, and say that they hope to bring out more men in the course of a week. Effort is being made to call out firemen's helpers in all mills, which if successful will seriously handicap operation. Conferences between the Eagle Lodge of Paper Makers, an organized labor group, and manufacturers have reached a point where it is expected that an agreement will be reached on the Buffalo wage scale. However, the American Writing Paper Co., operating sixteen mills, has disagreed with the independent companies on the individual contract and refuses to institute it.

John Crerar Library Moves to New Quarters

The John Crerar Library at Chicago has closed its doors for four months, during which period it will be moved to the new location at Michigan Ave. and Randolph St., opposite the Chicago Public Library. The long period for which the library will be closed works considerable hardship on the technical men of the city, and is due to the fact that Marshall Field & Co., in whose building it has been located, gave peremptory notice that the library could not remain open another day after April 30, the expiration of its lease. This is in spite of the fact that the library has occupied the quarters for over twenty-five years.

New Wood Reduction Plant at Hattiesburg, Miss.

Plans have been made and contract has been signed for a $500,000 wood reduction plant at Hattiesburg, Miss., for the Hercules Powder Co. of Wilmington, Del. Turpentine, pine oil and rosin will be extracted from pine stumps on 100,000 acres of cut-over pine lands. A 100-acre site has been purchased for reduction works and contracts for erecting sixteen plant buildings have been awarded to A. D. Little, Inc., Cambridge, Mass. About $3,000,000 will be the cost of plant and timber land development.

Publishers Plan to Buy Paper Mills

Fear of Government regulation in the control of paper stock has caused the newspapers to try to work out a plan of salvation. To avoid dealing in the spot market, the smaller publishers are devising a plan to buy and operate their own paper mills. Already two mills of combined output of 28,000 tons per year are under negotiation.

May Meeting of the American Section of the Society of Chemical Industry

Friday evening, May 21, Rumford Hall afforded the usual opportunity for the weekly gathering of chemists. On this occasion, the program attracted many men interested in glue and gelatine and industrial heating with gas. Sumner R. Church presided due to the absence of Charles E. Sholes. He stated that he as an industrial chemist was a firm believer in the Society of Chemical Industry. He said it had a peculiar field and the American Section should be built up to at least twice its present membership of 800.

Robert H. Bogue opened the program with a noteworthy paper on "Properties and Constitution of Glues and Gelatines." As this address embodied some of the subject matter which is to be published more elaborately in this journal during July, no attempt will be made to review the paper.

Research Opportunities in Gas Industry

In discussing "Opportunities Offered to Chemical Industry in the Manufacture of Gas," Robert M. Searle suggested some of the problems confronting the gas engineer to which chemical research could be profitably applied. Mr. Searle felt that some of the problems were of such fundamental importance that they were worthy of the life-long attention of trained scientists, and he made an earnest plea for an endowed foundation where the research man's efforts would not be diverted from the main problem by the routine worries of an operating plant.

Even at the present time, there is much to be learned on the distillation of coal in retorts. Other research opportunities are: the recovery of sulphur and ammonia, possibly in the form of ammonium sulphide; the development of a non-clinkering brick less costly than carborundum; desulphurizing spent oxide, possibly though the use of a solvent.

In conclusion, several views of the modern vertical retort plant of the Rochester Gas & Electric Corporation were shown. Although 450 tons of coal is carbonized per day, the labor required is only six workmen and two foremen per shift. By keeping the CO_2 content of the producer gas constant to within 0.1 per cent, the retort temperature does not vary more than 90 deg. F.

Gas as a Fuel for Industrial Heating

The importance of using gas as a fuel for heating in industrial plants was well presented by Dr. Henry O. Loebell. He considered the various fuels in use at the present time, such as coal, coke, crude oil, fuel oil and gas, and pointed out that not only was gas, particularly blue water gas, cheapest but possessed many other advantages. Storage, which takes up a large portion of space in a plant, is reduced to a minimum. Ashes, together with attendant grate troubles and ash-handling apparatus which accompanies the use of coal or coke, is entirely dispensed with. A finer and more accurate control of flame and temperature is possible and products of combustion leave no residue, thus insuring cleaner operation.

He emphasized the importance of flame temperature as well as B.t.u. content and stated that blue gas was the best fuel due to the fact that it burned more intensely, had a greater heat delivery and was actually the most efficient and economical fuel for most uses.

Canada's Pulp Wood Embargo May Cause Retaliation

The passing of laws by Canada forbidding United States paper companies holding leases entitling them to cut timber on crown lands and from exporting the wood unless made into pulp in Canada has imposed considerable hardship upon the paper manufacturers of this country. The purpose of this action is apparently an attempt to keep the foreign pulp and paper industry on its own resources and thereby give Canadian paper industry an added advantage.

Although opinion hostile to a modification of this measure is known to exist, the refusal will mean, as a matter of course, says Senator Underwood, that an attempt to get through Congress an embargo measure directed at Canada will follow.

Canada's newsprint production has increased from 150,000 tons in 1909 to 808,000 tons in 1919, made possible by imports of sulphur and coal from the United States, on which an embargo may be placed.

Position of Norwegian Industry

At the general meeting of the Industrial Federation of Norway, General Director Platou, who opened the meeting with a speech in which he gave interesting information about the situation of Norwegian industries, made the following statement: While in 1885 there were approximately 1,900 factories and works, the number in 1917 was 7,000. The total paid-up capital stock, which in 1913 amounted to approximately 375,000,000 crowns ($100,500,000), had risen to 782,000,000 crowns ($209,576,000) in 1917, and at the close of 1918 to 1,127,000,000 crowns ($302,036,000). Of the total value of imports into Norway, materials imported for manufacture amounted in the years from 1876 to 1880 to approximately 26 per cent and in 1917 to 65 per cent. At the same time the exports of industrial products rose from 11 per cent of the total value of Norwegian goods exported in 1876-1880 to 65 per cent in 1917. The returns that the speaker had obtained from a number of concerns showed that in the years 1913-1918 an average dividend of 8.87 per cent had been paid, which is considerably under what other trades yielded during the period.

Quebec Has $10,000,000 Maple Sugar Crop

The Quebec province maple sugar crop of this year was from one-fourth to one-half as great again as last year's and the value was estimated at $10,000,000. The number of trees tapped showed an increase of 1,000,000. This is a great increase over former years when one takes into consideration the fact that the value of the 1910 crop was estimated at only $1,000,000. The above does not represent the possible yields, however, as anywhere from one-half to two-thirds of the sap is wasted, either by running over from the sap buckets or by the fact that not all the available trees are tapped.

Another World's Fair Proposed

An international exhibition of arts, industries and manufactures, and the products of the soil, mine and sea, to take place in Philadelphia in 1926 to celebrate the 150th anniversary of the signing of the Declaration of Independence, is proposed in a bill which has been introduced by Representative Darrow of Pennsylvania.

Inventions by Government Employees

In reporting favorably to the Senate the bill increasing the force and salaries in the Patent Office, the Committee on Patents added to the bill, as a new section, the bill outlining a procedure for dealing with inventions and patents developed by Government employees in the course of their official duties. The new section is an exact copy of a bill which had passed the Senate previously. It was made a part of the measure to increase the force and salaries in the Patent Office so as to expedite its enactment into law. It is understood that there is no objection to the bill in the House. The reasons for enacting such legislation are set forth by the committee as follows:

> There is no fixed or general policy dealing with inventions and patents developed by Government employees in the course or as a result of their official duties, and consequently no governmental administrative machinery for translating such inventions and patents into actual public service.
>
> In cases where patents are developed by the combined efforts of Government employees and others, difficulties at present arise concerning the administration of the same because of the conflict between the rights of the inventors and those of the United States.
>
> There is no way at present by which patentees in or outside the Government service can dedicate their patents to the public with the assurance that the public will reap the full benefit therefrom, because an invention covered by a patent so dedicated does not interest capital, and because it may be excluded from public use by patents subsequently taken out by others.
>
> Conditions brought about by the war, causing an unprecedented demand for inventions, and the industrial developments and readjustments now following the war, call imperatively for guidance. Also the host of inventions developed during the war in the many Government bureaus and other organizations, primarily for war purposes, but which have a peace application of inestimable value, should be co-ordinated, conserved and translated into industrial use.
>
> There is provided a means aimed to be acceptable to the medical profession of patenting and consequently properly controlling inventions in the field of medicine and surgery, the control of patents by private interests being contrary to the ethics of the medical profession.
>
> It is desirable to have governmental administration of a certain type of patents, not ordinarily attractive to manufacturers, in order to provide production of needed devices or materials for governmental or public purposes.
>
> Provision is made for some remuneration to patentees, to stimulate invention.

The increases in the Patent Office as provided in the bill will call for an increased expenditure of $511,840.

Insectides and Charcoal

The Walnut Growers' Spray Manufacturing Co., a subsidiary of the California Walnut Growers' Association, has completed its new plant at Los Angeles and is now manufacturing several varieties of its "Nicodust" insecticides. These are preparations of nicotine in various strengths combined with other ingredients, to combat the many insect pests which afflict the trees and vegetables of the vicinity.

In connection with this plant the Arthur R. Maas Laboratories have recently finished the erection of equipment to produce poultry charcoal from the many tons of walnut shells which were formerly a waste product. Three tons of charcoal per day is being produced, a ready demand for the product being found among the large poultry ranches of southern California. Tar and creosote are also being recovered from the walnut shells and will be utilized. Harry L. Glaze is responsible for several successful mechanical engineering innovations in this installation.

Decennial Celebration at Forest Products Laboratory

The celebration of the tenth anniversary of the Forest Products Laboratory will be held at Madison, Wis., on July 22 and 23. Present plans call for a two-day program, including addresses by men prominent in science, industry and commerce, inspection of the laboratory, a banquet and various other forms of instruction and entertainment. It is proposed to make a permanent record of this decennial in the form of a souvenir publication to contain all of the addresses and other relevant matters, including the names of those who can permit a permanent record of their operative contributions to be made.

During the ten years of its existence the efforts of the laboratory have been devoted to the development of improved methods and processes for the better utilization of forest products of all kinds, and to the direct assistance of the industries concerned. Among the major lines of endeavor are the following:

Pulp and paper	Grading lumber
Hardwood and softwood distillation	Laminated construction
Preservation of wood	Chemistry of wood
Decay and decay prevention	Boxing, crating, packing
Mechanical properties of wood	Needle and leaf oils
Glues for wood	Ethyl alcohol from wood waste
Kiln drying and air seasoning	Wood finishes
Grading structural timbers	Aircraft parts
	Veneers and plywood
	Steam bending
	Identification of wood
	Microscopy of wood

During the war direct assistance was rendered the War and Navy Departments and various other branches of the Government in the solution of many important problems, particularly in connection with aircraft, gunstocks, artillery wheels, escort wagons, and the boxing and crating of arms and stores for overseas shipment. It was necessary, throughout this period, to abandon all work on the regular peacetime program.

The committee in charge of the program extends a hearty invitation to CHEMICAL & METALLURGICAL ENGINEERING readers to attend the celebration.

Cottonseed Mills Import Peanuts

A 4,000-ton shipment of shelled peanuts from China has arrived at Galveston, Tex. This is the first of a large consignment contracted for by cottonseed oil manufacturers since the war to keep their mills busy during the off season for cottonseed.

Research work by the Bureau of Chemistry at Washington on peanuts has developed a flour which when added in amounts of 20 to 25 per cent to wheat flour produces a bread containing enough protein for normal growth. This offers increased possibilities in the utilization of peanuts in addition to the extraction of peanut oil. Large shipments of copra to this country are also made. Experiments at Washington on copra press cakes indicate that when mixed with corn an adequate protein mixture for cattle feed can be made at reduced cost.

Pulp Wood Swept Out to Sea

High water broke the booms on the North River at Murray, B. C., Canada, and allowed nearly $500,000 of pulp wood belonging to the Cape Breton Pulp & Paper Co. to be swept out to sea. It is estimated that this will probably be a total loss.

Objections to Patent Bill

In an effort to meet objections raised by the industrial chemical industry, Representative Nolan, chairman of the Committee on Patents of the House of Representatives, has not pressed for consideration the bill authorizing the Federal Trade Commission to administer certain inventions and patents. The bill passed the Senate March 22. It also has been reported favorably by the House committee and is now on the House calendar.

It is feared in some quarters that the bill as drawn at present would give undue advantages to both actual and nominal Government inventors. At the request of the chairman of the committee, F. G. Cottrell, the Director of the Bureau of Mines, Carl L. Alsberg, Chief of the Bureau of Chemistry, and A. Stewart, one of the Bureau of Mines' specialists, have undertaken to draft certain restrictive amendments which will meet objections offered by the industrial chemists. Mr. Nolan has declined to reopen the hearings on the bill, which is as follows:

> A Bill authorizing the Federal Trade Commission to accept and administer for the benefit of the public and the encouragement of industry, inventions, patents, and patent rights, and for other purposes.
>
> Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Federal Trade Commission be, and hereby is, authorized and empowered to accept assignment of, or license or other rights or powers under, to develop, to issue or refuse to issue licenses under, to encourage the industrial use and application of, and otherwise to administer, on behalf of the United States, under such regulations and in such manner as the President shall prescribe, inventions, patents and patent rights which said commission deems it to the advantage of the public to be so accepted, as these may from time to time be tendered it by employees of the various departments or other establishments of the Government, or by other individuals or agencies; and to co-operate, as necessity may arise, with scientific or other agencies of the Government in the discharge of the duties herein set out.
>
> Sec. 2. That the Federal Trade Commission be, and is hereby, authorized and empowered to collect fees and royalties for licensing said inventions, patents and patent rights in such amounts and in such manner as the President shall direct, and shall deposit the same with the Treasurer of the United States; and of the total amount of such fees and royalties so deposited a certain per centum, to be determined by the President, shall be reserved, set aside, and appropriated as a special fund to be disbursed as directed by the President to remunerate inventors for such of their inventions, patents and patent rights contemplated by this Act as may prove meritorious and of public benefit.
>
> Sec. 3. That the Commissioner of Patents is hereby directed to grant all patents and record all assignments and licenses contemplated by this Act without the payment of any fee.

Canada to Establish a Research Bureau

To meet the keen competition in the industrial world in a more efficient manner, Canada is planning to establish a Bureau of Scientific Research at a cost of $600,000 for the grounds and building and $50,000 for salaries and upkeep. Mr. Cronyn, chairman of the committee appointed to consider this project, visited the bureaus of the United States, and made a report emphasizing the economies effected in public expenses in that country due to the work of the Bureau.

The standardization of all measures used in Canada for length, weight, volume, etc., and all forms of scientific apparatus and units of energy used in industry and public service will be the main work of the Bureau.

Robert W. Hunt the First Hunt Medallist

Herbert Hoover, speaking for the American Institute of Mining and Metallurgical Engineers, accepted a fund for the establishment of the Robert Woolston Hunt medal and award, before a large gathering May 27, 1920, at the Engineering Societies Building, New York City. The fund was proposed by the iron and steel committee of the Institute some months ago, but the privilege of establishing this memorial to the humanism, skill and learning of the Institute's past president was claimed by his partners and employees in business.

The medal is a very striking tablet, containing on one side a likeness of Captain Hunt, and on the other side a brawny steel-worker standing alongside a roll-train. It will be given not oftener than once yearly to the author of the best paper submitted to the Institute on the metallurgy of iron and steel. An award of a sum of money will also be given to the author of a meritorious paper on the same subject, it being understood that younger men only will receive this award, without being thereby debarred from also receiving the medal.

Mr. Hunt's business associate, John J. Cone, and his old friend Charles M. Schwab spoke at length upon his life, achievements and many good works, which are legion. As a fitting climax, President Hoover announced that the iron and steel committee had decided to award the first medal to its namesake, Captain Robert Woolston Hunt, nestor of steel metallurgists.

Belgians Seek Raw Material for Artificial Silk Here

Representatives of Belgian interests in the manufacture of artificial silk are now in this country negotiating for the purchase of cotton linters and chemicals as raw material used in its manufacture. Dr. Emil Bindschedler and his assistant, Dr. Juger, arrived in New York a few days ago to make tests on American linters and chemicals used in the manufacture of artificial silk.

Belgium is fast recovering from the effects of the war and is rapidly building up her industries, among which the production of artificial silk is very important. As no American material has been imported since before the war, she has had to depend upon surplus stock of the Allies. This supply is now running low and with the resumption of the Hungarian and Polish plants in addition to the main plant at Tubize it is necessary to procure larger quantities of raw material.

The Polish plant of Tubize at Tomazo, now a part of the new Polish state, has been enlarged to supply ammunition for the Polish Government in its war against the bolsheviki. Here, in addition to the manufacture of powder, about 9,000 lb. of artificial silk is produced daily, more than 3,000 workers being employed.

Experiment Station Devoted to Non-Metals

One of the new mining experiment stations for which an appropriation probably will be made, according to present plans, it is understood, will be devoted largely to the non-metals. As the non-metals represent the large raw-material supplies for the chemical industries, it is felt that intensive research of the character provided at mining experiment stations should be arranged for.

At present the Bureau of Mines is conducting six mining experiment stations. Four more have been authorized, but no appropriation for their establishment has been made. The sundry civil bill, which is about to become a law, is expected to provide funds for at least two additional stations.

Present Status of Bureau of Standards Samples

The Bureau of Standards will continue to prepare and issue standard samples during the coming fiscal year, although Congress has refused to continue the appropriation for the work. Since the money received from the sales of standard samples has always reverted directly to the Treasury, and is not available to the Bureau for any purpose whatsoever, the cost of procuring, preparing, standardizing and distributing the samples will necessitate the curtailment of other lines of established Bureau activities.

In the light of the above facts, it is earnestly requested that all users of standard samples refrain from any unnecessary waste of the material, and that educational institutions limit their use strictly to primary standardization and to advanced research.

A list of the standard samples issued by the Bureau, together with charges and ordering and shipping regulations, is given in the Bureau of Standards Supplement to Circular No. 25. In the future, standard samples will be issued only to users direct. This policy has been adopted to avoid, as far as possible, any chance of contamination or mixing of samples. Such chemical supply houses as have, in the past, carried a limited supply of certain standard samples for the accommodation of their customers can still render them service by remitting their orders with the proper fees to the Bureau for shipment.

Sample 50, which is a new chrome (3.6 per cent)-tungsten (17.5 per cent)-vanadium (0.75 per cent) steel sample, will be issued on or before July 1. Samples 23a, 0.8C bessemer steel, and 51, a new 1.2C electric furnace steel, will be issued on or before Sept. 1.

Book Reviews

THE PHYSICAL CHEMISTRY OF THE METALS. By *Rudolph Schenck*, translated and annotated by *Reginald S. Dean*. 1st Edition. John Wiley & Sons, Inc., New York, 1919. 239 pp. Price, $3.

This acceptable translation of what ought to become a very widely studied and extremely useful book is very welcome. The German original first appeared in paper covers, and was the verbatim report of a series of lectures delivered at Aix-la-Chapelle before engineers of the Rhenish industrial district to "deepen their understanding" of smelting operations and metallurgical processes. Doubtless the hearer's curiosity was aroused rather than his understanding deepened, for the subject matter covered is so wide that only a broadly educated and studious engineer could grasp all the different phases, while owing to limitation of space only cursory mention could be made of them—evidently a treatment not calculated to "deepen the understanding" of an expert. For instance, in the introductory chapter or Lecture I, on the Properties of Metals, no less than twenty-six sub-topics are considered, many of them worthy of a lecture or a series of lectures in themselves. Fancy compressing into two or three pages such subjects as Polymorphy, Determination of the Transition Point, Enantiotropy and Monotropy, or Electron Theory!

On the other hand, the few words on all these topics cannot but whet the appetite of any seriously-minded student for more and detailed information furnished in the various footnote references to the literature. In the hands of the expert, however, it will contain, in small compass, comprehensive mention of the wide ramifications of physical chemistry as applied to metals, and many side-lights upon any problem he may have under investigation, often with actual data available for use. Thus, Giolitti in his classical studies on cementation of iron and steel was able to use Schenck's Figs. 102, 103 and 104 in arriving at a rational explanation of the bizarre fact that some alloy steels emerged from the case-hardening operation deeply carburized yet superficially oxidized, and to define the precise limits of pressure and temperature in order to avoid such an unwelcome product.

During war times the original book was excessively rare in the United States. Possibly its form was such as not to attract the attention of the general metallurgical profession quickly, and its importations were therefore few in number. At any rate, for several years it was found impossible to purchase a copy or even to secure a loan. Now its appearance in English should do much to "deepen the understanding" by stimulating the study of physical chemistry as applied to smelting, metallurgical working and heat treatment on the part of all those who are really striving to make good metal better. E. E. THUM.

Personal

Dr. C. L. ALSBERG, Chief of the Bureau of Chemistry, has been attending a conference in Chicago at which he met the Bureau's district chiefs and inspectors. The object of the meeting was to plan the work for the next fiscal year.

Dr. J. H. ANDREW, chief of the metallurgical research department of Sir W. G. Armstrong, Whitworth & Co., Manchester, England, has been appointed to the chair of metallurgy in the Royal Technical College, Glasgow, Scotland, vacant by the transfer of Dr. Desch to the University of Sheffield.

E. J. BARTELLS, manager Wood Pipe Export Co., of Portland, Ore., visited San Francisco during the Seventh National Trade Council convention.

J. H. BECQUE has resigned his fellowship at the Mellon Institute to accept the position of assistant superintendent at the Plasterco, Va., plant of the United States Gypsum Co.

C. E. BEECHER, formerly with the Union Oil Co. of California, has been added to the staff of the Bartlesville station of the Bureau of Mines.

M. E. COOLEY, dean of the department of engineering at the University of Michigan, spoke before the Michigan Manufacturers' Association at its annual meeting at Detroit on a plan of the university for helping the country by doing industrial research work for small concerns.

HOWARD ELLIOTT and L. B. STILLWELL were elected directors of the United States Chamber of Commerce at the recent annual meeting at Atlantic City. Mr. Elliott is a member of the American Society of Civil Engineers and chairman of the board of the Northern Pacific R.R. Mr. Stillwell is past president of the American Institute of Consulting Engineers and of the American Society of Electrical Engineers and a member of the American Society of Civil Engineers. Both are from New York City.

Dr. ARTHUR W. DOX has resigned as chief in chemistry of the Iowa Agricultural Experiment Station to accept the position of research chemist for Parke, Davis & Co., Detroit, Mich.

JOHN B. FERGUSON, formerly of the Geophysical Laboratory of the Carnegie Institution of Washington, D. C., and now a member of the research department of the Western Electric Co. of New York City, has accepted a position as associate professor of chemical research at the University of Toronto.

Dr. WILLARD J. FISHER, assistant professor of physics of the University of the Philippines, and since July, 1919, acting head of the department, will leave the university this summer and return to the United States.

L. F. GORDON, business manager of *Ingenieria Internacional*, read the address prepared by James H. McGraw,

president of McGraw-Hill Co., Inc., on "The Service of the Business Press," at the Seventh National Foreign Trade Council convention in San Francisco, Cal.

F. M. KIRSCH, manager Wood Pipe Export Co., delivered an address in San Francisco at the Seventh National Foreign Trade Council convention on "The Webb Law in Operation."

CHARLES F. LEDERER, until recently superintendent of way of the Milwaukee Electric Railway & Light Co., Milwaukee, Wis., has become associated with the rail welding department of the Metal & Thermit Corporation, New York City.

Dr. A. W. OWENS, who has been at the Bureau of Standards as associate chemist in the metallurgical chemistry section for about two years, has resigned and will take up work as research chemist on the staff of the United States Smelting, Refining & Mining Co., about July 1.

D. H. SIMPSON, who has been a member of the physical chemistry section of the Bureau of Standards, leaves this position about June 10 to take up a new line of work in Chicago. This is the third separation from this section within the last few months and it is being considered whether the work of this section will not have to be discontinued until additional funds are available for the chemistry division of the Bureau.

E. T. STANNARD, vice-president of the Alaska Steamship Co., has been elected a vice-president of the Kennecott Copper Corporation. Mr. Stannard will move his headquarters from the mines at Kennecott to Seattle, Wash.

GEORGE H. TOMLINSON has accepted a position as research chemist with the Riordan Pulp & Paper Co., Ltd., at Hawkesbury, Ont.

CHARLES W. TRIGG has changed his headquarters from the Mellon Institute of Industrial Research, where he has been engaged in coffee investigation for the past four years, to the King Coffee Products Corporation of Detroit, Mich., in the capacity of chief chemist. His connection with the former organization will still be retained.

Current Market Reports

The Non-Ferrous Metal Market

New York, May 31, 1920.—Copper market unchanged from spot to July 31. Mercury again weakened, falling from $92 to $87.50. Markets of rare metals, like other markets, very uncertain. Tin declined 2½c. in the last week.

	Cents per Lb.
Copper, electrolytic	19.25
Aluminum, 98 to 99 per cent	32@33
Antimony, wholesale lots	9.37½
Nickel, ordinary	43.00
Nickel, electrolytic	45.00
Tin, Straits, spot	50.00
Lead, New York, spot	8.80
Lead, E. St. Louis, spot	8.60
Zinc, spot, New York	7.50
Zinc, spot, E. St. Louis	7.50

OTHER METALS

Silver	oz.	$1.02½
Cadmium	lb.	1.40@1.50
Bismuth (500 lb. lots)	lb.	2.70
Cobalt	lb.	2.70@3.00
Magnesium (f.o.b. Niagara Falls)	lb.	1.60@1.85
Platinum	oz.	95.00
Iridium	oz.	300@400
Palladium	oz.	110.00
Mercury	75 lb.	87.50

FINISHED METAL PRODUCTS	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	29.50
Copper bottoms	38.00
Copper rods	27.50
High brass wire and sheets	25.25
High brass rods	23.75
Low brass wire and sheets	27.25
Low brass rods	28.00
Brazed brass tubing	37.00
Brazed bronze tubing	41.75
Seamless copper tubing	32.00
Seamless high brass tubing	30.50

SCRAP METALS	Cents per Lb. Buying Price
Aluminum, cast scrap	21.75@22.75
Aluminum, sheet scrap	21.25@22.50
Copper, heavy machinery comp	13.50@14.00
Copper, heavy and wire	13.50@13.75
Copper, light and bottoms	12.25@12.75
Copper, heavy cut and crucible	14.75@15.00
Brass, heavy	7.25@ 7.75
Brass, light	6.75@ 7.25
No. 1 clean brass turnings	8.00@ 8.25
No. 1 comp. turnings	10.00@10.50
Lead, tea	4.25@ 4.75
Lead, heavy	6.75@ 7.00
Zinc, scrap	4.25@ 4.50

The Chemical and Allied Industrial Markets

New York, May 28, 1920.

General indications seem to point to somewhat less strained conditions than have been prevalent for the past few weeks, although there is little to report in the way of actual business or price changes. The supply of *sodium nitrite* is better than it has been for the past few weeks and offerings as low as 19@19½c. per lb. for car lot and 20@20½c. for less than car lot have been heard during the period. One factor in this item has withdrawn all offerings on the grounds that material sold at this figure would mean a loss when the cost of shipment from abroad is considered. There has been no break as yet in the present *glycerine* rise and although 26½@28½c. per lb. still holds as a firm price, sales as high as 30c. have been rumored during the week. Among the heavy chemicals *carbon tetrachloride* is suffering from lack of transportation facilities and prices ranging from 13½@15½c. per lb. are being asked for spot material which is easily accessible.

COAL-TAR PRODUCTS

The seriousness of the Japanese money situation is making itself felt in this market. Contracts that producers have been striving to get for some time back are being cancelled by foreign buyers, who are finding it impossible, in the present situation, to meet the conditions of their original agreements. The transportation tie-up is not as complete as it was two weeks ago, but nothing in the way of relief to the depleted spot market has arrived. *Naphthalene* is still holding up around 15c. per lb., while flake and balls are difficult to find at 15½@17c. and 16@18c., respectively. Surplus Government supplies of *phenol* are still being offered at 12@20c. per lb., while *benzol* continues in very small offerings with quotations ranging between 27@36c. per gal. for pure, water white, and 25@31c. for the 90 per cent grade.

NAVAL STORES

Turpentine has been gradually declining during the period and latest reports have it as low as $2.27 per gal. There is enough material on the New York market to take care of the local demand, but up to the present there has been no attempt made to resume the exporting of this item. The *rosins* failed to come down with turpentine and as far as can be discovered there is no material being offered, even at the listed prices in the table, which are for the most part wholly nominal.

OILS

The vegetable oil market continues in a weak position with indications of still lower offerings in order to draw the buyers back into the market. Very little interest is being displayed in *linseed*, which came down to $1.65 raw, car lots, and $1.67, boiled, car lots, while *palm*, lagos, also dropped to 12½@13½c. per lb. from 13½@14½c. Offerings of *cocoanut*, ceylon grade, at 17½@18½c. and cochin at 18½@19½c. per lb. seem to be the average prices, which are 1c. below the previous report made last week in this journal.

Chicago, May 26, 1920.

More than one dealer and user of chemicals in Chicago has characterized current conditions as "coming back to earth." Conditions in regard to shipping seem to be improving, in that considerable quantities of all sorts of commodities are being received and bills of lading indicating

goods in transit are coming through the mail with increasing regularity. Shipments from a producing point direct to Chicago are coming through with the least interference, while those which are routed through any one of the great freight switching yards are invariably delayed. Receipts here indicate the New York yards as the most congested point, import freight through that terminal being the most difficult of clearance.

Two weeks ago we mentioned that the freight tie-up had served to isolate Chicago and to render quotations here independent of conditions in the rest of the world. This is now true in a slight degree only, as receipts are sufficient to bring this market back into correlation with New York. General inactivity is noted. While this is, in a measure, due to the fact that wise buyers stay out of a market when they know available materials are very scarce, it is felt that general business conditions are mostly to blame. Banking interests everywhere are holding credit lines very tight, and slow deliveries have made purchasers slow in paying bills. This limits the amount of money available. Coupled with this, a well defined feeling of uncertainty as to future industrial and trade conditions renders everyone reluctant to accumulate any great stocks. As a result, users of chemical products are operating on a hand to mouth basis, with an eye on the future.

Heavy Chemicals

Improvement in conditions has made itself felt in an increase in the available supply of *alcohol*. It is not yet plentiful but can now be obtained in reasonable quantities. Today's quotation on *ethyl* grade in barrels is \$5.57½ per gal. for immediate delivery. Owing to the high price no one is buying more than enough for immediate needs. Second hands in broken package quantities are bringing \$6 to \$7 a gal. *Methyl* grade seems harder to get than ethyl. A nominal quotation is made on this grade of \$2.65 per gal. for 95 per cent, though none was found offered for actual delivery at that figure. Spot goods could command 10c. higher if the buyer had to have the goods. *Denatured*, 190 proof, while obtainable, continues to increase in price, being offered today at \$1.09@\$1.11. *Formaldehyde* is about the same as when last mentioned, current small transactions ranging around 62@65c.

Cancellation of large orders of alkali products for the Far East have broken the heavy demand on makers and an immediate reaction in price was felt in *soda ash* and *caustic soda*. The former, quoted a fortnight ago at 4½@5c., is now obtainable at 3¾@4c. on contract. *Caustic soda*, worth 7c. on contract two weeks ago, is from ½c. to ¾c. lower. Spots in both these commodities remain unchanged, as the local stock condition remains bad. Lower prices seem only a matter of a little time, therefore trading is inactive. *Bleaching powder* at 5c. per lb. and *sal soda* at \$1.60 cwt., f.o.b. Chicago, show no recent appreciable change.

Under lightened demand, spot quotation on *blue vitriol*, large crystals, is off ½c. from former quotation, to 8c. per lb. Prices of makers for contract delivery show no change. *Copperas* is holding firm at \$2.75 cwt., which seems high, but is probably justified by existing scarcity of supply. *Mercury*, closely following the New York market, is offered at \$95 a flask, which represents a 10 per cent increase in the past month. *Sodium nitrite* has again been subject to violent fluctuation, today's quotation being around 30c. per lb. The past two weeks have seen quotations on this item ranging from 25c. upward.

Coal-Tar Products

As in other chemical lines, the grip of the traffic tie-up seems to be gradually lessening, though the entire market is, as yet, in bad shape. The entire range of prices seems too high and buyers are necessarily not going beyond positive week-to-week requirements. The market has been spotty for some time, quotations being of value for the one day only. The general trend seems to be downward and must remain so for business to resume a healthy tone. Among the crudes, 28@29c. per gal. is quoted on *benzol*, with producers booked up solid for some time to come and local stocks at the minimum. *Cresol* is in readier supply at 15c. and the trade is absorbing production easily. *Toluol* continues strong at 31c., with producers well sold up. *Naphthalene* remains in heavy demand, but buyers refused to close at recent high figures. Flakes as a result are down 2c. to 15c. a lb. and balls to 16c.

The acids, in general, are strongly held, with but little business being done. *Picric* alone seems in good supply, current price being 24c. per lb. for local stock. *Benzoic* is held at 90c. on U.S.P. grade for later delivery, but scant stocks have run dealers' price up to \$1. Technical grade is still quoted at 75c. per lb. Manufacturers are holding firm at 60c. per lb. on *salicylic* acid, c.p. grade, for future delivery. Holders of local stocks have been forced by lack of purchasers to reduce prices to 55c. Fluctuations on all these items are of wide range and rapid. Intermediates remain on too high a level to interest buyers. *Aniline oil*, quoted at 37@38c. per lb., has felt a severe slump in demand, as also has *aniline* salt, quoted at 48@50c. Lower prices must prevail before much business is transacted. A market scarcity has developed in *anthracene*, it now being quoted at \$1 per lb. for 80 per cent.

Vegetable Oils

Supply is easier but demand continues light. The general tendency to refrain from buying beyond present-day needs is heavily felt in this line, and although prices have held to quotations last given, except for a few fractional declines, the weakness is evident. Current business in *soya bean*, *corn* and *cottonseed* oils is at a minimum. Some *cocoanut oil* is changing hands on a basis of 17c. per lb. for Manila grade in sellers' tanks, f.o.b. coast. Local quotation on *linseed oil* remains at \$2.05 for raw, \$2.07 for boiled, in barrels, carload lot quotations on bulk falling off a few cents to \$1.60@\$1.65. Rail troubles have closed some producers and caused a short supply, but consumption in construction operations has likewise fallen off. The future of this particular item is hard to forecast, though lower prices seem probable.

St. Louis, Mo., May 25, 1920.

The transportation situation, as affected by the rail strike, while continuing to show improvement, is still far from normal. Considerable time must elapse before the present depleted local stocks of chemicals are replenished and conditions become stabilized. Especially is this true for chemicals which are not manufactured locally or where local production is limited. The curtailment of production of other industries which are large consumers of chemicals has to a certain extent relieved the situation.

The demand for heavy chemicals continues to be good and in many cases exceeds the supply.

Sulphuric Acid. — The demand is good and prices show little increase in past two weeks. The 60-deg. grade is quoted at \$15 to \$16 per ton and the 66-deg. grade \$22 per ton. Oleum is quoted at \$27.50 per ton.

Muriatic Acid.—The demand continues heavy and local supply is sold up. The 18-deg. grade is quoted at \$21 per ton. No increase for past two weeks.

Nitric Acid.—Prices unchanged. Quoted in carload lots at \$7 per hundred for 36-deg., \$8 for 38-deg., \$9 for 40-deg., \$10 for 42-deg.

Acetic Acid.—The demand is heavy and local stocks low. Prices show increase. Spot transaction for glacial grade 18½c. per lb.

Phenol.—Demand good and supply plentiful due to local firm disposing of surplus Government stock. Quotation unchanged at 12c. per lb. in large quantities.

Zinc Chloride.—Unchanged and quoted at \$3.50 to \$3.75 per hundred.

Caustic Soda.—Supply very limited and prices unstable. Quoted at 7c. per lb. for 76-per-cent test in drum.

Sodium Carbonate.—Local supplies very low. Sales reported at \$2.25 per hundred.

Soda Ash.—Demand exceeds supply. Quoted carload lots in barrels at \$4.50 per hundred.

Sodium Nitrate. — Supply limited and prices increasing. Quotations for spot transactions 6c. per lb.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	.....	$0.65 – $0.75
Acetone	lb.	$0.15 –$0.20	.21 – .22
Acid, acetic, 28 per cent	cwt.	3.50 – 3.75	4.00 – 4.25
Acetic, 56 per cent	cwt.	6.00 – 6.50	8.75 – 9.00
Acetic, glacial, 99½ per cent., carboy	cwt.	15.50 –16.00	16.50 – 18.00
Boric, crystals	lb.	.15 – .15½	.15½– .16½
Boric, powder	lb.	.15 – .15½	.15 – .16
Citric	lb.	1.05 – 1.12	1.17 – 1.18
Hydrochloric (nominal)	cwt.	2.00 – 2.50	3.50 – 4.00
Hydrofluoric, 52 per cent	lb.	.12 – .12½	.13½– .14
Lactic, 44 per cent tech	lb.	.11 – .11½	.12 – .16
Lactic, 22 per cent tech	lb.	.04½– .05½	.06 – .07
Molybdic, C. P	lb.	4.00 – 4.50	4.50 – 5.00
Muriatic, 20 deg. (see hydrochloric)		.....	.....
Nitric, 40 deg	lb.	.06 – .07	.07½– .08½
Nitric, 42 deg	lb.	.07½– .08	.08½– .09½
Oxalic, crystals	lb.	.55 – .57	.60 – .65
Phosphoric, Ortho, 50 per cent solution	lb.	.22 – .23	.24 – .25
Picric	lb.	.28 – .35	.40 – .50
Pyrogallic, resublimed	lb.	2.50 – 2.55	2.60 – 2.65
Sulphuric, 60 deg., tank cars	ton	14.00 –18.00	.....
Sulphuric, 60 deg., drums	ton	.....	.....
Sulphuric, 66 deg., tank cars	ton	23.00 –25.00	.....
Sulphuric, 66 deg., drums	ton	35.00 –40.00	50.00 – 55.00
Sulphuric, 66 deg., carboys	ton	36.00 –40.00	50.00 – 55.00
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	27.00 –30.00	37.00 – 42.00
Sulphuric, fuming, 20 per cent (oleum) drums	ton	28.00 –30.00	38.00 – 42.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	32.00 –35.00	40.00 – .....
Tannic, U. S. P	lb.	1.50 – 1.60	1.65 – 1.70
Tannic (tech.)	lb.	.....	.60 – .90
Tartaric, crystals	lb.	.....	.80 – .85
Tungstic, per lb. of WO	lb.	.....	1.20 – 1.40
Alcohol, Ethyl (nominal)	gal.	5.10 – 5.50	6.00 – 7.00
Alcohol, Methyl, 95%	gal.	.....	2.50 – 2.70
Alcohol, Methyl, pure	gal.	.....	3.50 – 3.55
Alcohol, denatured, 188 proof (nominal)	gal.	.....	1.05 – 1.10
Alcohol, denatured, 190 proof (nominal)	gal.	.....	1.00 – 1.05
Alum, ammonia lump	lb.	.04½– .05	.05½– .06
Alum, potash lump	lb.	.07½– .08½	.09 – .09½
Alum, chrome lump	lb.	.15½– .18	.19 – .20
Aluminum sulphate, commercial (nominal)	lb.	.01½– .02	.02½– .03½
Aluminum sulphate, iron free	lb.	.02½– .03	.04 – .04½
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07½– .10¾	.11 – .12
Ammonia, anhydrous, cylinders (100-150 lb.)	lb.	.32 – .35	.35 – .40
Ammonium carbonate, powder	lb.	.16 – .16½	.17 – .17½
Ammonium chloride, granular (white salammoniac) (nominal)	lb.	.16 – .16½	.17 – .18
Ammonium chloride, granular (gray salammoniac)	lb.	.12½– .13½	.13½– .14½
Ammonium nitrate	lb.	.08½– .12	.....
Ammonium sulphate	lb.	.07 – .07½	.08½– .....
Amylacetate	gal.	.....	5.00 – .....
Amylacetate tech	gal.	.....	4.75 – 5.25
Arsenic, oxide, lumps (white arsenic)	lb.	.....	.13½– .14½
Arsenic, sulphide, powdered (red arsenic)	lb.	.23 – .24	.....
Barium chloride	ton	150.00–160.00	1.75 – 2.00
Barium dioxide (peroxide)	lb.	.21 – .23	.24 – .25
Barium nitrate	lb.	.09½– .11	.11 – .12
Barium sulphate (precip.) (blanc fixe)	lb.	.04½– .05	.05½– .06
Bleaching powder (see calcium hypochlorite)		.....	.....
Blue vitriol (see copper sulphate)		.....	.....
Borax (see sodium borate)		.....	.....
Brimstone (see sulphur, roll)		.....	.....
Bromine	lb.	.70 – .90	1.00 – 1.05
Calcium acetate	cwt.	3.50 – 3.55	.....
Calcium carbide	lb.	.04½– .04½	.04½– .05½
Calcium chloride, fused, lump	ton	23.00 –25.00	30.00 – 40.00
Calcium chloride, granulated	lb.	.01½– .01¾	.02 – .02½
Calcium hypochlorite (bleaching powder)	cwt.	4.00 – 4.25	4.50 – 5.50
Calcium peroxide	lb.	.....	1.50 – 1.70
Calcium phosphate, monobasic	lb.	.....	.75 – .80
Calcium sulphate, pure	lb.	.....	.25 – .30
Carbon bisulphide	lb.	.08 – .09	.10 – .11
Carbon tetrachloride, drums	lb.	.11 – .11½	.12 – .15½
Carbonyl chloride (phosgene)	lb.	.....	.80 – 1.05
Caustic potash (see potassium hydroxide)		.....	.....
Caustic soda (see sodium hydroxide)		.....	.....
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.09 – .09½	.10 – .10½
Chloroform	lb.	.30 – .35	.36 – .38
Cobalt oxide	lb.	.....	2.00 – 2.05
Copperas (see iron sulphate)		.....	.....
Copper carbonate, green precipitate	lb.	.27 – .28	.29 – .31
Copper cyanide	lb.	.....	.65 – 70
Copper sulphate, crystals	lb.	.08 – .09	.09 – .09½
Cream of tartar (see potassium bitartrate)		.....	.....
Epsom salt (see magnesium sulphate)		.....	.....
Ethyl Acetate Com. 85%	gal.	1.35 –	1.40 – .....
Ethyl Acetate pure (acetate ether 98% to 100%)		.....	1.75 – .....
Formaldehyde, 40 per cent (nominal)	lb.	.36 – .40	.57 – .65
Fusel oil, ref	gal.	.....	5.25 – 6.00
Fusel oil, crude (nominal)	gal.	.....	.....
Glauber's salt (see sodium sulphate)		.....	.....
Glycerine	lb.	.....	.26½– .28½
Iodine, resublimed	lb.	4.30 – 4.35	4.40 – 4.45
Iron oxide, red	lb.	.....	.03 – .20
Iron sulphate (copperas)	cwt.	1.50 – 1.75	1.80 – 2.00
Lead acetate, normal	lb.	.....	.13½– .15½
Lead arsenate (paste)	lb.	.11 – .12	.13 – .17
Lead nitrate, crystals	lb.	.....	.90 – 1.00
Litharge	lb.	.14 – .15	.15½– .16
Lithium carbonate	lb.	.....	1.50 – .....
Magnesium carbonate, technical	lb.	.12 – .14	.15 – .16
Magnesium sulphate, U. S. P	100 lb.	3.00 – 3.55	4.00 – 4.50
Magnesium sulphate, commercial	100 lb.	.....	3.25 – 3.60
Nickel salt, double	lb.	.....	.14 – .16
Nickel salt, single	lb.	.....	.16 – .18
Phosgene (see carbonyl chloride)		.....	.....
Phosphorus, red	lb.	.50 – .55	.60 – .65
Phosphorus, yellow	lb.	.....	.35 – .37
Potassium bichromate	lb.	.35 – .37	.45 – .46
Potassium bitartrate (cream of Tartar)	lb.	.52 – .56	.57 – .58
Potassium bromide, granular	lb.	.80 – .85	.90 – .95
Potassium carbonate, U. S. P	lb.	.....	.85 – .88
Potassium carbonate, crude	lb.	.21 – .25	.26 – .28
Potassium chlorate, crystals	lb.	$0.15 –$0.16	$0.21 – .....
Potassium hydroxide (caustic potash)	lb.	.28 – .29	.31 – .35
Potassium iodide	lb.	.....	3.35 – 3.60
Potassium nitrate	lb.	.15 – .17	.19 – .21
Potassium permanganate	lb.	.75 – .80	.85 – .95
Potassium prussiate, red	lb.	.90 – 1.00	1.05 – .....
Potassium prussiate, yellow	lb.	.32 – .36	.36½– .37½
Potassium sulphate (powdered)	ton	$225.00 –240.00	.....
Rochelle salts (see sodium potas. tartrate)		.....	.....
Salammoniac (see ammonium chloride)		.....	.....
Sal soda (see sodium carbonate)		.....	.....
Salt cake	ton	28.00 –32.00	.....
Silver cyanide (nominal)	oz.	.....	1.25 – .....
Silver nitrate (nominal)	oz.	.....	.74 – .76
Soda ash, light	100 lb.	.....	3.50 – 3.60
Soda ash, dense	100 lb.	.....	3.55 – 3.65
Sodium acetate	lb.	.08½– .09	.09½– .12
Sodium bicarbonate	100 lb.	2.25 – 2.60	2.75 – 3.50
Sodium bichromate	lb.	.32 – .35	.36 – .37
Sodium bisulphate (nitre cake)	ton	7.00 – 7.50	8.00 – 10.00
Sodium bisulphite Powered	lb.	.06 – .06½	.07 – .10½
Sodium borate (borax)	lb.	.09 – .10	.11 – .12
Sodium carbonate (sal soda)	100 lb.	1.60 – 1.80	1.80 – 2.00
Sodium chlorate	lb.	.....	.10 – .11
Sodium cyanide, 96-98 per cent	lb.	.24 – .25	.26 – .27
Sodium fluoride	lb.	.18 –	.19 – .20
Sodium hydroxide (caustic soda)	100 lb.	4.25 – 6.00	6.25 – 6.50
Sodium hyposulphite	lb.	.....	.03 – .04
Sodium molybdate	lb.	2.50 –	3.25½– .....
Sodium nitrate	100 lb.	3.00 – 3.25	3.75 – 4.00
Sodium nitrite	lb.	.19 – .19½	.20 – .21
Sodium peroxide, powdered	lb.	.32 – .35	.35 – .40
Sodium phosphate, dibasic	lb.	.03½– .04½	.04½– .05
Sodium potassium tartrate (Rochelle salts)	lb.	.....	.39 – .40
Sodium prussiate, yellow	lb.	.23 – .27	.31 – .32
Sodium silicate, solution (40 deg.)	lb.	.01½– .02	.02 – .02½
Sodium silicate, solution (60 deg.)	lb.	.02½– .03	.04 – .05
Sodium sulphate, crystals (Glauber's salt)	cwt.	1.60 – 1.70	1.75 – 2.00
Sodium sulphide, crystal, 60–62 per cent (cone)	lb.	.09 – .10	.10½– .11
Sodium sulphite, crystals	lb.	.03½–	.04 – .06
Strontium nitrate, crystals	lb.	.20 – .21	.25 – .26
Sulphur chloride	lb.	.05½–	.06 – .....
Sulphur, crude	ton	22.00 –	.....
Sulphur dioxide, liquid, cylinders	lb.	.09 –	.10 – .12
Sulphur (sublimed), flour	100 lb.	3.35 –	3.40 – 3.65
Sulphur, roll (brimstone)	100 lb.	3.20 –	3.30 – 3.40
Tin bichloride (stannous)	lb.	.42½–	.46 – .50
Tin oxide	lb.	.60 – .63	.65 – .....
Zinc carbonate, precipitate	lb.	.16 – .18	.19 – .20
Zinc chloride, gran	lb.	.13 –	.13½– .17
Zinc cyanide	lb.	.49 –	.50 – .60
Zinc dust	lb.	.12½–	.13 – .15
Zinc oxide, U. S. P	lb.	.18 – .19	.20 – .21
Zinc sulphate	lb.	.03½– .03¾	.04 – .06

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha naphthol, crude	lb.	.....	—	$1.25
Alpha naphthol, refined	lb.	.....	—	1.45
Alpha naphthylamine	lb.	.65	—	.70
Aniline oil, drums extra	lb.	.35	—	.40
Aniline salts	lb.	.45	—	.50
Anthracine, 80% in drums (100 lb.)	lb.	.90	—	1.00
Benzaldehyde (f.f.c.)	lb.	2.00	—	2.10
Benzidine, base	lb.	1.35	—	1.40
Benzidine, sulphate	lb.	1.20	—	1.25
Benzoic acid, U.S.P.	lb.	.90	—	1.10
Benzoate of soda, U.S.P.	lb.	.80	—	1.00
Benzol, pure, water-white, in drums (100 lb.)	gal.	.27	—	.36
Benzol, 90%, in drums (100 lb.)	gal.	.25	—	.31
Benzyl chloride, 95-97%, refined	lb.	.35	—	.40
Benzyl chloride, tech	lb.	.25	—	.35
Beta naphthol benzoate (nominal)	lb.	.50	—	.65
Beta naphthol, sublimed (nominal)	lb.	.....	—	1.00
Beta naphthol, tech (nominal)	lb.	.75	—	.85
Beta naphthylamine, sublimed	lb.	2.25	—	.40
Cresol, U. S. P., in drums (100 lb.)	lb.	.18	—	.19
Ortho-cresol, in drums (100 lb.)	lb.	.23	—	.25
Cresylic acid, 97-99%, straw color, in drums	gal.	1.10	—	1.20
Cresylic acid, 95-97%, dark, in drums	gal.	1.00	—	1.05
Cresylic acid, 50%, first quality, drums	gal.	.65	—	.75
Dichlorbenzol	lb.	.08	—	.10
Diethylaniline	lb.	.....	—	1.80
Dimethylaniline (nominal)	lb.	1.50	—	1.55
Dinitrobenzol	lb.	.30	—	.37
Dinitroclorbenzol	lb.	.30	—	.35
Dinitronaphthaline	lb.	.45	—	.55
Dinitrophenol	lb.	.40	—	.45
Dinitrotoluol	lb.	.40	—	.45
Dip oil, 25%, tar acids, car lots, in drums	gal.	.38	—	.40
Diphenylamine (nominal)	lb.	.....	—	.85
H-acid (nominal)	lb.	2.25	—	2.50
Metaphenylenediamine	lb.	1.15	—	1.30
Monochlorbenzol	lb.	.12	—	.15
Monoethylaniline	lb.	1.70	—	1.85
Naphthaline crushed, in bbls. (250 lb.)	lb.	.15	—	.....
Naphthaline, flake	lb.	.15½	—	.17
Naphthaline, balls	lb.	.16	—	.18
Naphthionic acid, crude	lb.	.75	—	.85
Nitrobenzol	lb.	.14	—	.19
Nitro-naphthaline	lb.	.40	—	.50
Nitro-toluol	lb.	.20	—	.30
Ortho-amidophenol	lb.	3.25	—	4.25
Ortho-dichlor-benzol	lb.	.15	—	.20
Ortho-nitro-phenol	lb.	.80	—	1.25
Ortho-nitro-toluol	lb.	.25	—	.40
Ortho-toluidine	lb.	.35	—	.45
Para-amidophenol, base	lb.	2.50	—	3.50
Para-amidophenol, HCl	lb.	2.50	—	3.25
Para-dichlor-benzol	lb.	.08	—	.12
Paranitraniline	lb.	.....	—	1.65
Para-nitro-toluol	lb.	1.35	—	1.50
Paraphenylenediamine	lb.	2.60	—	3.00
Paratoluidine	lb.	2.00	—	2.50
Phthalic anhydride	lb.	.65	—	.75
Phenol, U. S. P., drums (dest.), (240 lb.)	lb.	.12	—	.20
Pyridin	gal.	2.00	—	3.50
Resorcin, technical	lb.	4.25	—	4.50
Resorcin, pure	lb.	6.25	—	6.75

Salicylic acid, tech., in bbls. (110 lb.)	lb.	$0.50	—	$0.52
Salicylic acid, U. S. P.	lb.	.55	—	.60
Salol	lb.	.90	—	1.00
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25	—	.31
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.19	—	.24
Sulphanilic acid, crude	lb.	.28	—	.32
Toluidine	lb.	1.70	—	2.50
Toluidine, mixed	lb.	.45	—	.55
Toluol, in tank cars	gal.	.28	—	.....
Toluol, in drums	gal.	.29	—	.32
Xylidine, drums, 100 gal.	lb.	.44	—	.50
Xylol, pure, in drums	gal.	.37	—	.45
Xylol, pure, in tank cars	gal.	.35	—	.....
Xylol, commercial, in drums, 100 gal.	gal.	.37	—	.45
Xylol, commercial, in tank cars	gal.	.23	—	.27

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.36	—	$0.39
Beeswax, refined, light	lb.	.39	—	.40
Beeswax, white pure	lb.	.63	—	.68
Carnauba, No. 1. (nominal)	lb.	.93	—	.95
Carnauba, No. 2, regular (nominal)	lb.	.85	—	.88
Carnauba, No. 3, North Country (nominal)	lb.	.44	—	.45
Japan	lb.	.21	—	.22
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.09½	—	.10
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.....	—	.10
Paraffine waxes, refined, 118-120 m.p.	lb.	.11½	—	.12
Paraffine waxes, refined, 128-130 m.p.	lb.	.13	—	.14
Paraffine waxes, refined, 133-135 m.p.	lb.	.15½	—	.16½
Paraffine waxes, refined, 135-137 m.p.	lb.	.17½	—	.18½
Stearic acid, single pressed	lb.	.25	—	.26
Stearic acid, double pressed	lb.	.26	—	.27
Stearic acid, triple pressed	lb.	.28	—	.29

NOTE—Quotations on paraffine waxes are nominal.

Flotation Oils

All prices are f.o.b. New York, unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp. gr., 0.930-0.940	gal.	$1.75
Pine oil, pure, dest. dist.	gal.	1.60
Pine tar oil, ref., sp. gr. 1.025-1.035	gal.	.48
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.35
Pine tar oil, double ref., sp. gr. 0.965-0.990	gal.	.85
Pine tar, ref., thin, sp. gr., 1.080-1.960	gal.	.36
Turpentine, crude, sp. gr., 0.900-0.970	gal.	1.75
Hardwood oil, f.o.b. Mich., sp. gr., 0.960-0.990	gal.	.35
Pinewood creosote, ref.	gal.	.52

Naval Stores

The following prices are f.o.b., New York, for carload lots.

Rosin B-D, bbl.	280 lb.	$19.50	—	$20.30
Rosin E-I	280 lb.	20.30	—	20.50
Rosin K-N	280 lb.	21.00	—	23.00
Rosin W. G.-W. W.	280 lb.	23.50	—	24.00
Wood rosin, bbl.	280 lb.	17.80	—	18.50
Spirits of turpentine	gal.	2.27	—	2.30
Wood turpentine, steam dist.	gal.	2.30	—	2.35
Wood turpentine, dest. dist.	gal.	1.90	—	2.00
Pine tar pitch, bbl.	200 lb.	.....	—	8.50
Tar, kiln burned, bbl. (500 lb.)	bbl.	14.50	—	15.00
Retort tar, bbl.	500 lb.	15.00	—	15.50
Rosin oil, first run	gal.	.87	—	.89
Rosin oil, second run	gal.	.89	—	.92
Rosin oil, third run	gal.	1.04	—	1.05
Rosin oil, fourth run	gal.	1.12	—	1.15

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.40
70-72 deg., steel bbls. (85 lb.)	gal.	.38
68-70 deg., steel bbls. (85 lb.)	gal.	.37
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.29

Crude Rubber

Para—Upriver fine	lb.	$0.38	—	$0.38½
Upriver coarse	lb.	.28½	—	.29½
Upriver caucho ball	lb.	.30½	—	.....
Plantation—First latex crepe	lb.	.....	—	.38
Ribbed smoked sheets	lb.	.37½	—	.38
Brown crepe, thin, clean	lb.	.....	—	.35
Amber crepe No. 1	lb.	.....	—	.40

Oils

VEGETABLE

The following prices are f.o.b., New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.18½	—	$0.20
Castor oil, AA, in bbls.	lb.	.20	—	.22
China wood oil, in bbls.	lb.	.22½	—	.23½
Cocoanut oil, Ceylon grade, in bbls.	lb.	.17½	—	.18½
Cocoanut oil, Cochin grade, in bbls (nominal)	lb.	.18½	—	.19½
Corn oil, crude, in bbls.	lb.	.17½	—	.18
Cottonseed oil, crude (f.o.b. mill)	lb.	.15½	—	.16
Cottonseed oil, summer yellow	lb.	.19	—	.19½
Coteonseed oil, winter yellow	lb.	.21	—	.22
Linsed oil, raw, car lots (domestic)	gal.	1.65	—	.....
Linseed oil, raw, tank cars (domestic)	gal.	1.60	—	.....
Linseed oil, boiled, car lots (domestic)	gal.	1.67	—	.....
Olive oil, commercial	gal.	3.10	—	3.25
Palm, Lagos	lb.	.12½	—	.13½
Palm, bright red	lb.	.13	—	.13½
Palm, Niger	lb.	.11	—	.12
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.16½	—	.17½
Peanut oil, refined, in bbls.	lb.	.22	—	.24
Rapeseed oil, refined in bbls.	gal.	1.70	—	1.72
Rapeseed oil, blown, in bbls.	gal.	1.80	—	1.85
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.17	—	.18
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.13	—	.13½

FISH

Winter pressed Menhaden	gal.	$1.17	—	$1.18
Yellow bleached Menhaden	gal.	1.20	—	1.22
White bleached Menhaden	gal.	1.23	—	1.24
Blown Menhaden	gal.	1.30	—	1.32

Miscellaneous Materials

All f. o. b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$20.00	—	$22.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	16.00	—	18.00
Barytes, crude, 88%@94% ba., Kings Creek	net ton	8.00	—	10.00
Blanc fixe, dry	lb.	.05½	—	.06
Blanc fixe, pulp	ton	60.00	—	80.00
Casein	lb.	.15	—	.18
Chalk, English, extra light	lb.	.05	—	.07
Chalk, English, light	lb.	.05	—	.06
Chalk, English, dense	lb.	.04½	—	.05
China clay (Kaolin) crude, f.o.b. Pkin, Va.	net ton	8.00	—	12.00
China clay (Kaolin), imported, lump	ton	25.00	—	35.00
China clay (Kaolin), imported, powdered	ton	30.00	—	60.00
Feldspar (nominal) f.o.b. N. Y. State	ton	13.50	—	18.00
Feldspar, crude, f.o.b. Maryland and North Carolina, points	net ton	7.50	—	8.00
Feldspar, ground, f.o.b. Baltimore	net ton	18.00	—	25.00
Fire clay, f.o.b. Baltimore	net ton	5.00	—	7.00
Fuller's earth, domestic, powdered	ton	25.00	—	30.00
Fuller's earth, imported, powdered	ton	35.00	—	40.00
Graphite (dust polish grade 30%) Ashland, Ala.	lb.	.....	—	0.01
Graphite (dust facing grade 50%) Ashland, Ala.	lb.	.....	—	0.01½
Graphite, crucible, 85% carbon Ashland, Ala.	lb.	.....	—	.07
Graphite, crucible, 90% carbon Ashland, Ala.	lb.	.....	—	.08½
Pumice stone, imported	lb.	.03	—	.06
Pumice stone, domestic	lb.	.02½	—	.....
Quartz (acid tower) fist to head, f.o.b. Baltimore	net ton	.....	—	10.00
Quartz (acid tower) 1½@2 in., f.o.b. Baltimore	net ton	.....	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	.....	—	17.00
Shellac, orange, fine	nominal lb.	1.50	—	.....
Shellac, orange, superfine	lb.	1.60	—	1.65
Shellac, A. C. garnet	lb.	1.30	—	1.35
Soapstone	ton	15.00	—	25.00
Talc, domestic	ton	20.00	—	60.00
Talc, imported	ton	60.00	—	70.00

Refractories

Following prices are f.o.b. Works:

Chrome brick	net ton $75-80 at Chester, Penn.
Chrome cement	net ton 45-50 at Chester, Penn.
Clay brick, 1st quality fireclay	1,000 45-50 at Clearfield, Penn.
Clay brick, 2nd quality	1,000 40-45 at Clearfield, Penn.
Magnesite, dead burned	net ton 50-55 at Chester, Penn.
Magnesite brick, 9 x 4½ x 2½ in.	net ton 85-90 at Chester, Penn.
Silica brick	1,000 50-55 at Mt. Union, Penn

Ferro-Alloys

All Prices f.o.b. Works

Ferro-carbon-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00	—	$250.00
Ferro-chrome, per lb. of Cr. contained, 6-8% carbon	lb.	.20	—	.21
Ferro-chrome, per lb. of Cr. contained, 2-4% carbon	lb.	.21	—	.22
Ferro-manganese, 70-80% Mn.	gross ton	200.00	—	250.00
Spiegeleisen, 16-20% Mn.	gross ton	73.00	—	75.00
Ferro-molybdenum, per lb. of Mo.	lb.	2.25	—	2.75
Ferro-silicon, 50%	gross ton	80.00	—	90.00
Ferro-silicon, 75%	gross ton	150.00	—	200.00
Ferro-silicon, 10-15%	gross ton	60.00	—	65.00
Ferro-tungsten, 70-80%, per lb. of contained W.	lb.	.90	—	1.10
Ferro-uranium, 35-50%, of U	lb.	7.00	—	.....
Ferro-vanadium, 30-40% per lb. of contained V.	lb.	6.50	—	7.75

Ores and Semi-finished Products

All Prices f. o. b. Mines

Chrome ore, 35-40%, Cr_2O_3, f.o.b. Atlantic Seaboard	unit	$0.70	—	$0.85
Coke, foundry, f.o.b. ovens	net ton	15.50	—	16.50
Coke, furnace, f.o.b. ovens	net ton	14.50	—	15.50
Petroleum coke, refinery, Atlantic seaboard	net ton	.....	—	24.00
Fluor spar, gravel, f.o.b. mines	net ton	25.00	—	30.00
*Fluor spar, acid grade, lump, f.o.b. Tonuco, Mex.	net ton	30.00	—	45.00
*Fluor spar, acid grade, ground, f.o.b. Tonuco	net ton	55.00	—	65.00
Manganese ore, 45% Mn and over	unit	.80	—	.95
Manganese ore, chemical (MnO_2)	gross ton	80.00	—	90.00
Molybdenite, 85% MoS_2, per lb. of MoS_2	lb.	.75	—	.85
Tungsten, Scheelite, 60% WO_3 and over, per unit of WO_3	unit	7.00	—	10.00
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3	unit	6.50	—	7.50
Uranium oxide, 96%	lb.	2.75	—	3.00
Vanadium pentoxide, 99%	lb.	12.00	—	14.00
Vanadium Ore	lb.	1.00	—	3.00
Pyrites, foreign, lump	unit	.17	—	.....
Pyrites, foreign, fine	unit	.17	—	.....
Pyrites, domestic, fine	unit	.16	—	.17½
Ilmenite, 52% TiO_2	lb.	.02	—	.....
Rutile, 95% TiO_2	lb.	.11	—	.....
Carnotite, minimum 2% U_3O_8, per lb. of U_3O_8	lb.	2.75	—	3.00
Zircon, washed, iron free	lb.	.10	—	.....
Monazite, per unit of ThO_2	unit	42.00	—	.....

*Nominal

Structural Steel

Mill, Pittsburgh

Beams and channels, 3 to 15-in.	100 lb.	$2.45@		$4.00
Angles, 3 to 6-in., ¼-in. thick	100 lb.	2.45@		4.00
Tees, 3-in. and larger	100 lb.	2.45@		4.00
Plates	100 lb.	2.65@		4.00
Rivets, structural, ½-in. and larger	100 lb.	4.50		
Rivets, conehead for boilers, ½-in. and larger	100 lb.	4.60		
Sheets, No. 28 black	100 lb.	4.35@		6.50
Sheets, No. 10 blue annealed	100 lb.	3.55@		6.00
Sheets, No. 28 galvanized	100 lb.	5.70@		8.50

For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gage; for galvanized corrugated sheets, add 15c., all gages.

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

California

EL SEGUNDO—The General Chemical Co., 25 Broad St., New York City, has awarded the contract for a group of factory buildings, to the J. G. White Eng. Corp., 43 East Exch. Pl. Estimated cost, $2,000,000.

LOS ANGELES—Wilson & Co., 1000 Lyons St., plans to build an oleomargerine factory. Estimated cost, $100,000.

Colorado

BURLINGTON — The School Bd. plans to build a 2-story, 90x90-ft. high school. A chemical laboratory will be installed in same. Estimated cost, $60,000. H. G. Hoskin, secy.

Connecticut

ELMWOOD (Hartford P. O.)—The Abbot Ball Co. has awarded the contract for the construction of a 1-story, 50x80-ft. factory for the manufacture of steel balls, to the J. H. Grazier Co., 721 Main St., Hartford. Estimated cost, $18,000.

HARTFORD—The Bd. Educ. plans to construct a 2-story, 160x200-ft. high school in the western section of the city. A chemical laboratory will be installed in same. Estimated cost, $500,000. W. Marchant, archt.

MANSFIELD DEPOT—The Mansfield State Training School has awarded the contract for the construction of a 1-story, 40x50-ft. filter plant, etc., to Canning & Leary, Harris Bldg., New London. Estimated cost, $35,000. Noted May 19.

District of Columbia

WASHINGTON—J. A. Wetmore, supervising archt., will receive bids until June 22 for furnishing the labor and materials in connection with the proposed extension to the animal house for the Hygienic Laboratory, United States Public Health Service, here.

Florida

PALATKA—The McGuire Fertilizer Co., Morristown, plans to construct a fertilizer mixing plant in St. John's County near here. Estimated cost, $200,000.

Illinois

AUGUSTA—The Bd. Educ. will soon award the contract for the construction of a 2-story high school here. Laboratory equipment will be installed in same. Estimated cost, $100,000. H. R. Temple, Champaign, archt.

CHICAGO—The Chicago Solder Co., 218 North Union Ave., has awarded the contract for the construction of a 2-story, 50x250-ft. addition to factory, to the E. L. Scheidenheim Co., 111 West Monroe St. Estimated cost, $100,000. Noted Feb. 4.

Maryland

BALTIMORE — The Maryland Color Printing Co., Holliday and Hillen Sts., has awarded the contract for the construction of a 17-story, 100x110x135-ft. plant, to the Consolidated Eng. Co., 243 Calvert Bldg. Estimated cost, $2,000,000.

CUMBERLAND — The Kelly-Springfield Tire Co., has awarded the contract for the construction of a 3- and 4-story, 575x620-ft. rubber tire plant on River Rd., to the Hunken Conky Constr. Co., Cleveland, Ohio. Estimated cost, $2,000,000.

Minnesota

MINNEAPOLIS—The Modern Fdry. & Machine Co., 4725 Dupont Ave. S., is having plans prepared for the construction of a 1-story, 80x150-ft. steel foundry. Estimated cost, $60,000. L. J. Bedard, pres.

Missouri

ST. LOUIS—The Amer. Bed Co., 1820 McNulty St., has awarded the contract for the construction of a 2-story, 75x130-ft. paint shop on Park Ave., to the Fruin-Colnon Contg. Co., Merchants Laclede Bldg. Estimated cost, $30,000.

New Hampshire

MANCHESTER — The Notre Dame Hospital plans to build a chemical diagnosis building on Concord St. Plans include a surgical, genito-urinary, orthopedic, X-ray, oral surgery, dentistry, and various other departments. Estimated cost, $60,000. G. S. Foster, 967 Elm St., secy.

New Jersey

SAYREVILLE—The borough plans to construct a water supply system which will have a daily capacity of 250,000 gal. Plans include filters, etc. Waldo S. Coulter, 114 Liberty St., New York City, engr.

TRENTON — The Ajax Rubber Co., Breunig Ave., has awarded the contract for the construction of a 4-story, 60x100-ft. rubber factory on North Olden Ave., to the N. A. K. Bugbee Co., 206 East Hanover St. Estimated cost, $60,000.

TRENTON—The Thermoid Rubber Co., Whitehead Rd., has awarded the contract for the construction of a rubber factory addition, to Karno-Smith Co., Broad St. Bank. cost, $175,000. The company is in the market for $100,000 worth of machinery for same.

North Carolina

GASTONIA—The mayor will receive bids until June 8 for the construction of a waterworks extension and sewer system including a 2,000,000-gal. filtration tank and a purification plant. W. M. Piatt, Durham, engr.

Ohio

AKRON—The Supreme Cord Tire & Rubber Co. plans to construct a factory on a 9½-acre site on Home Ave.

CLEVELAND—The Cleveland Welding & Mfg. Co., West 117th St. and Berea Rd., will soon award the contract for the construction of a 1-story, 90x155-ft. factory. Estimated cost, $75,000.

CLEVELAND—The Modern Aluminum Fdry. Co., 4613 Payne Ave., has awarded the contract for the construction of a 1-story, 50x143-ft. factory addition, to H. G. Claxton, Vickers Bldg. Estimated cost, $50,000.

CUYAHOGA FALLS—The Falls Rubber Co. has awarded the contract for the construction of a 3-story, 61x84-ft. factory addition, to the A. A. Lane Constr. Co., 1836 Euclid Ave., Cleveland. Estimated cost, $60,000. Noted May 4.

Pennsylvania

PHILADELPHIA—The Yarnall Paint Co., 1026 Race St., has awarded the contract for altering a paint factory, to R. C. Ballinger & Co., 218 North 13th St. Estimated cost, $30,000.

West Virginia

BARRACKSVILLE—The Bd. Educ. plans to build a high school. A chemical and physical laboratory will be installed in same. L. L. Friend, state supervisor of high school buildings.

BLUEFIELD—The Bd. Educ. plans to build a junior high school. A chemical and physical laboratory will be installed in same. Total estimated cost, $200,000. L. L. Friend, state supervisor of high school buildings.

FAIRMONT — The Union Independent School Bd. plans to build a high school in the eastern section of the city. A chemical and physical laboratory will be installed in same. Estimated cost, $125,000. L. L. Friend, state supervisor of high school buildings.

HUNTINGTON—The Bd. Educ. plans to build a junior high school. A chemical and physical laboratory will be installed in same. A $62,000 bond issue has been passed for the project. L. L. Friend, state supervisor of high school buildings.

MONTGOMERY—The Bd. Educ. plans to build a high school. A chemical and physical laboratory will be installed in same. Estimated cost, $125,000. L. L. Friend, state supervisor of high school buildings.

RAVENSWOOD—The Bd. Educ. plans to build a high school. A chemical and physical laboratory will be installed in same. A $62,000 bond issue has been passed for the project. L. L. Friend, state supervisor of high school buildings.

Ontario

CHATHAM—The city plans to install 3 mechanical pressure filters in connection with its waterworks system. Estimated cost, $30,000. F. Adams, City Hall, engr.

Coming Meetings and Events

THE AMERICAN CHEMICAL SOCIETY will hold its fall meeting in Chicago, Sept. 7 to 10 inclusive.

THE AMERICAN CHEMICAL SOCIETY, N. Y. Section, will hold a regular meeting June 11, at the Chemists' Club.

THE AMERICAN DROP FORGE ASSOCIATION will hold its seventh annual convention at the Marlborough-Blenheim Hotel, Atlantic City, N. J., June 17, 18 and 19.

THE AMERICAN ELECTROPLATERS' SOCIETY will hold its eighth annual convention in Rochester, June 30 to July 3. Headquarters will be at the Seneca Hotel.

THE AMERICAN FOUNDRYMEN'S ASSOCIATION will meet in Columbus, Ohio, Oct. 4 to 8 inclusive.

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its twelfth semi-annual meeting as follows: June 28 and 29 will be spent in Montreal, June 30 in Ottawa, July 1 in Ontario, July 2 in Shawinigan Falls, July 3 in La Tuque, July 4 in Chicoutimi and July 5 in Quebec.

THE AMERICAN PHYSICAL SOCIETY will hold a meeting Nov. 27 at the Case School of Applied Science, Cleveland, and the annual meeting, beginning Dec. 28, at Chicago, the latter being the occasion of the special quadrennial meeting of the American Association for the Advancement of Science and the Affiliated Societies.

THE AMERICAN SOCIETY FOR TESTING MATERIALS will hold its annual meeting at the New Monterey Hotel, Asbury Park, N. J., June 22 to 25.

THE AMERICAN STEEL TREATERS' SOCIETY, Chicago, will hold its second annual convention and exhibit, combined with the convention of the Steel Treating Research Society of Detroit, Mich., in the Coliseum Museum, Philadelphia, Pa., Sept. 14 to 18 inclusive.

THE CANADIAN INDUSTRIAL CONGRESS will be held at Victoria, B. C., June 2 to 10.

THE INSTITUTE OF METALS DIVISION OF THE A.I.M.E. will hold its usual joint meeting with the American Foundrymen's Association at Columbus, Ohio, during the week beginning Oct. 4.

THE IRON AND STEEL INSTITUTE (British) will hold its autumn meeting at Cardiff by invitation of the Ironmasters and Steel Manufacturers of South Wales and Monmouthshire. The date of the meeting will be Tuesday, Sept. 21, for the assembling of the members at Cardiff, and the formal proceedings will open on the morning of Wednesday, Sept. 22.

THE SIXTH NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES will be held in the Grand Central Palace, New York City, Sept. 20 to 25.

THE NATIONAL FERTILIZER ASSOCIATION will hold its twenty-seventh annual convention at the Greenbrier, White Sulphur Springs, W. Va., the week of June 21.

THE NEW JERSEY CHEMICAL SOCIETY will hold a regular meeting and ladies' day Saturday afternoon and evening, June 5, at Rutgers College, New Brunswick, N. J.

THE NORTHERN OHIO SECTION OF THE AMERICAN CERAMIC SOCIETY will hold its summer meeting June 7 at Sandusky, Ohio. Visits will be made to the Sandusky Bulb Works of the General Electric Co., and the business meetings will be held at Cedar Point.

THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION will hold its twenty-seventh annual meeting June 29 to July 3, at the University of Michigan, Ann Arbor, Mich.